HOMECOMING

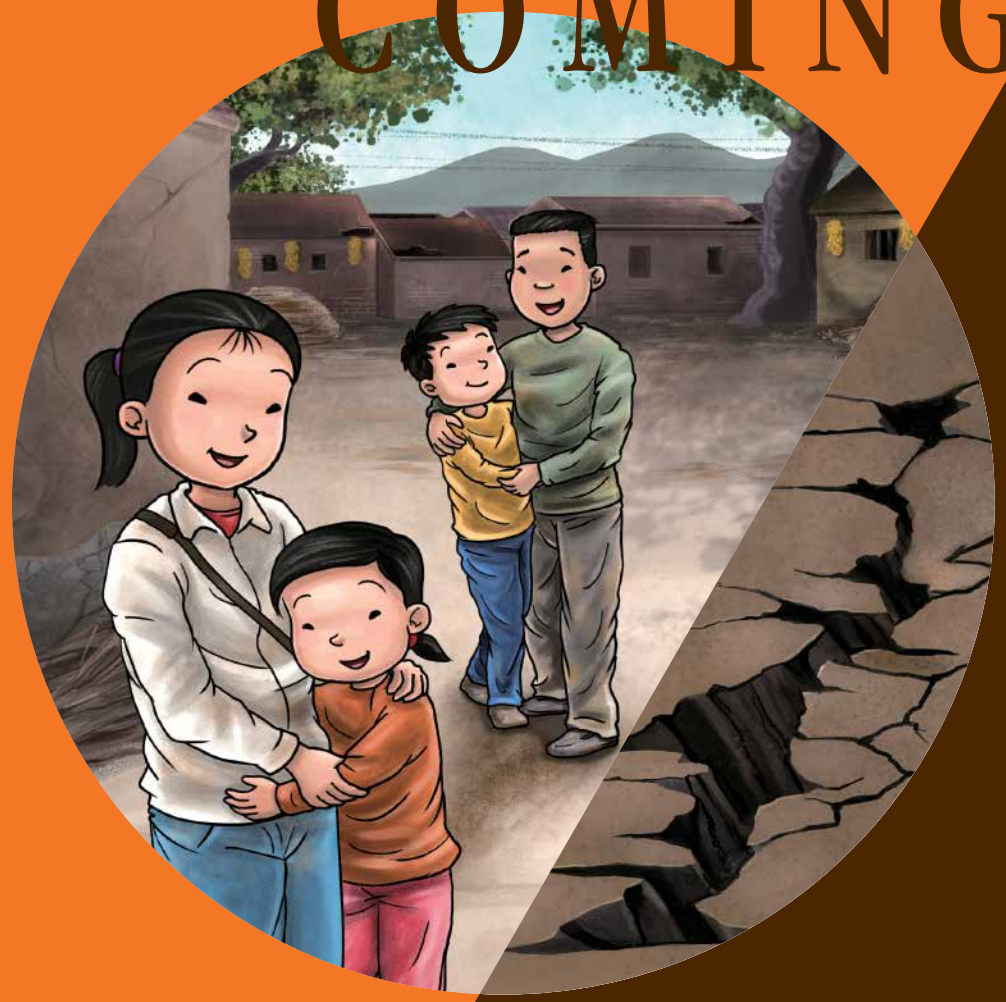
A story about how a strong earthquake affects a family with "left-behind" children (Version for the General Public)

A story about how a strong earthquake affects a family with "left-behind" children

Version for the General Public

HOME COMING

New Concept for Disaster Prevention, Mitigation and Relief in China in the New Era



Janise Rodgers, Guiwu Su, Timothy Sim, Philip England, John Young, Wenhua Qi and others

This scenario describes how a repeat of the historical 1568 Shaanxi Northeast Xi'an earthquake could impact a family with "left-behind" children in a rural village in Weinan, if it occurred in the present day.

New Concept for Disaster Prevention, Mitigation and Relief in China in the New Era

This project aligns with China's new approach to disasters, which is to:

Prioritize prevention; combine prevention with preparedness and rescue; unify regular disaster reduction and extraordinary disaster relief; shift focus from post-disaster relief to prevention beforehand, from coping with single disasters to comprehensive disaster reduction, and from reducing losses to mitigating disaster risks; fully raise the comprehensive capability of the whole society to resist natural disasters.

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and others

CAUTION

This hypothetical scenario is NOT a prediction of a specific disaster. It does NOT mean that an earthquake akin to the one described will happen in Weinan in the near future. No one knows when or where the next earthquake might occur, nor how large and damaging it might be.

The family's hypothetical story, and the study upon which it is based, provide an example of what may happen if the 1568 earthquake were to strike in present day Weinan. People can learn from it to plan for safer outcomes before a real earthquake occurs.

The scenario is intended only for use in planning, preparedness, and raising awareness of local earthquake risk. Some actions taken by the children in the story's village setting may not be advisable in other contexts. The authors, funders, publisher and other contributors to this report are not responsible for any interpretation or use beyond the purposes stated.

A NOTE FOR READERS

This document is intended for the general public in Weinan, who already know their community well. For readers not local to the area, including international readers, this note provides basic background about Weinan.

Weinan is located in Shaanxi Province, to the east of Xi'an in the Wei River valley. *Please see the map on page 10.* The two municipal districts of the study area this story describes, Linwei and Huazhou, contain the main urban areas of Weinan (a prefecture, which is a larger administrative area with additional districts), as well as large rural areas located in the valley, the yellow-soil (loess) plateau, and the Qinling mountain to the south. As of 2017, Linwei and Huazhou districts had a total population of over 1.3 million and a Gross Domestic Product of 46.6 billion RMB.

Linwei District adjoins eastern Xi'an, which is one of the most historically and culturally important areas of the country with numerous heritage sites. Weinan was devastated by the deadliest earthquake in recorded history, the 1556 Huaxian earthquake (approximately M8). Today Weinan remains at risk from numerous active earthquake faults in the Wei River valley.

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BACKGROUND INFORMATION

This earthquake scenario narrative is a product of an international collaboration (PAGER-O: Pan-participatory Assessment and Governance of Earthquake Risks in the Ordos Area) funded by the National Natural Science Foundation of China (NSFC) and by the Natural Environment Research Council (NERC) and the Economic and Social Research Council (ESRC) of the UK. This programme aimed to combine the strengths of physical and social sciences to increase resilience and reduce risks from multi-hazards in earthquake-prone regions in China.

The PAGER-O project focused on the Ordos area with the specific goal of bridging the gaps between science and policy and between top-down and bottom-up approaches to disaster risk reduction (DRR) to improve resilience to earthquakes. The project used a highly collaborative, participatory approach to develop an earthquake scenario for Weinan City, which brought together a trans-disciplinary team of international and Chinese physical science, social science, policy and engineering researchers and local stakeholders to co-identify earthquake risk, co-explore pathways to earthquake resilience, and motivate co-operative action for reducing earthquake risk.

The main implementation organizations of the PAGER-O project include:

China

- Institute of Geology, China Earthquake Administration (CEA)
- China Earthquake Disaster Prevention Center (CEDPC)
- The Hong Kong Polytechnic University, China

United Kingdom and United States

- Overseas Development Institute (ODI), UK
- Department of Earth Sciences, University of Oxford, UK
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The principal investigators (PIs) of the project are:

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United Kingdom

- John Young from Overseas Development Institute
- Philip England from Department of Earth Sciences, University of Oxford

PI Guiwu Su provided overall project leadership and guidance, as did PIs John Young and Philip England. The scenario's narrative story was written by Janise Rodgers with assistance from numerous team members including Guiwu Su, Timothy Sim, Wenhua Qi, Chunlan Guo, Junlei Yu, Arrietta Chakos and Philip England, translated into Chinese by Guiwu Su and the CEA team, and illustrated by Siu Kuen Lai. It is based on active fault investigations by Xijie Feng and Ji Ma; ground shaking estimates by Kun Chen and Barry Parsons; loss estimation calculations for rural buildings by Li Zhiqiang's team at CEA, for urban buildings by Wang Dongming's team of CEDPC, and for landslides by David Milledge and Alexander Densmore; qualitative observations of infrastructure vulnerability led by Craig Davis and Wenhua Qi; and social science research by Guiwu Su and the CEA team, and Timothy Sim and the PolyU team. John Young and Yue Cao provided policy and process guidance, while Emily So provided casualty estimation expertise. Janise Rodgers and Arrietta Chakos provided expertise on creating and using earthquake scenarios. The ideation and discussion of the overall structure of the narrative was led by Janise Rodgers, Guiwu Su and Timothy Sim, while the detailed style of the book was designed by Sandy Lui.

BRIEF INTRODUCTION OF THE CONTENTS

The scenario is supported by a dozen technical papers in academic journals that document the basis for the hypothetical but plausible earthquake, on which the scenario is built, and which explain the basis for calculations of vulnerabilities and risks to the city of Weinan and its surrounding areas, if such an earthquake were to occur. This technical analysis is accompanied by two audience-specific narratives of what the impacts might be on the Weinan area in the event of such, aiming to facilitate bridging the gap between sciences and policies to reduce earthquake risk. The first audience is government staff, while the second is the general public. The aim of the two different narratives is to facilitate bridging the top-down and the bottom-up approaches to improving earthquake safety, preparedness, and resilience.

The narrative presented here is for public use. It includes the following three aspects.

First, a graphic novel describes a fictional local, rural family with "left-behind" children, and their experiences in the scenario earthquake and its aftermath. The storylines of this novel were carefully constructed to highlight the key earthquake risk problems that Weinan faces.

Second, key results of the scenario are presented succinctly; detailed scientific information can be found in the technical papers mentioned above.

The third aspect is the provision of basic knowledge on earthquake disasters, basic information on earthquake safety for the general public, and tips on family earthquake disaster preparedness.

The last two aspects were woven around the storylines to help the local public to easily understand the narrative and in the hope of encouraging people to make use of the basic knowledge, information, and skills to build their own bottom-up pathways to earthquake risk reduction and make themselves and their families safer.

ACKNOWLEDGMENTS

The PAGER-O project involved the contributions of a large number of other local organizations, researchers and stakeholders working to reduce disaster risk. In particular, the authors sincerely thank the following organizations for their substantial help and participation during the progress of the work: various divisions of Shaanxi Earthquake Agency, Weinan Earthquake Administration, Earthquake Administration Office of Huazhou district of Weinan, Weinan Education Administration, other numerous Weinan agencies in the Leading Group on Protecting Against and Mitigating Earthquake Disasters of Weinan, Shaanxi Key Laboratory of Disasters Monitoring & Mechanism Simulation based at Baoji University of Arts and Sciences, School of Architecture and Civil Engineering of Xi'an University of Science and Technology, Gender Development Solution of Shaanxi Province, and Environmental Education Center of Beijing Normal University.

Sincere thanks go to many others, too numerous to name. Many Shaanxi or Beijing-based consultants gave constructive comments and advice either on the development of the earthquake scenario, or on its communication products, or on application or replication directions of this kind of scenario approach. Special thanks go to over 15 thousand local primary or high school students, their teachers and parents, and the general public for their cooperative responses to questionnaires, surveys, and interviews about earthquake disaster awareness, preparedness and resilience. Thanks go to the CCTB Translation Service in assisting the translation of "New Concept for Disaster Prevention, Mitigation and Relief in China in the New Era".

Homecoming – A story about how a strong earthquake affects a family with "left-behind" children (Version for the General Public)

Janise Rodgers, Guiwu Su, Timothy Sim, Philip England, John Young, Wenhua Qi and others

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1568

What is an Earthquake Scenario?

Scenario Earthquake

1568

Gaoling (Northeast Xi'an)

Approximately Magnitude 7 (M7)

A scenario tells the story of a plausible earthquake and how it would likely affect people, the community, and the places we live. The consequences are based on standard methods that engineers and scientists use to estimate the shaking, damage and impacts on people that a given earthquake may cause. This scenario story describes what could happen to one family in the Linwei and Huazhou Districts of Weinan if the 1568 earthquake occurred in the present day. **It is not a prediction of a specific disaster. It does not mean that an earthquake like the one described will happen in Weinan in the near future.** No one knows when or where the next earthquake might occur, nor how large and damaging it might be. Rather, this scenario is an example to help you understand specific consequences, decide how you might respond, and learn what you can do now to lessen the impacts of any future earthquake. This scenario begins with an earthquake at 14:02 on a Saturday in April.

Ask yourself:

- Where will I be?
- Where are my children, my spouse, my parents?
- Has my family and community prepared for an earthquake?
- Do we know what to do during heavy shaking, to stay safe?
- What must I do first? Who will need me?

The damage and consequences this story describes need not happen. Weinan residents and officials can take action now to that will reduce future earthquake damage, protect people's lives and make the community safer and more resilient.

2018

Simulated Scenario Impacts

Present days

Linwei and Huazhou Districts, Weinan

A rural family

BEIJING

WEINAN

XI'AN

SHANGHAI

The Characters

HAIYAN

In her 30s, daughter-in-law, works waiting tables at a restaurant in Xi'an

GRANDMA

60 years old, mother of Jianguo and Jianjun, she looks after two grandchildren and their orchard, in a village on the Weinan tableland

XIAOSHUAI

12-year-old grandson, attends school in a neighboring village

XIAOMEI

8-year-old granddaughter, attends school in a neighboring village

UNCLE JIANJUN

28 years old, younger son, a veteran, works as a government officer in Weinan

JIANGUO

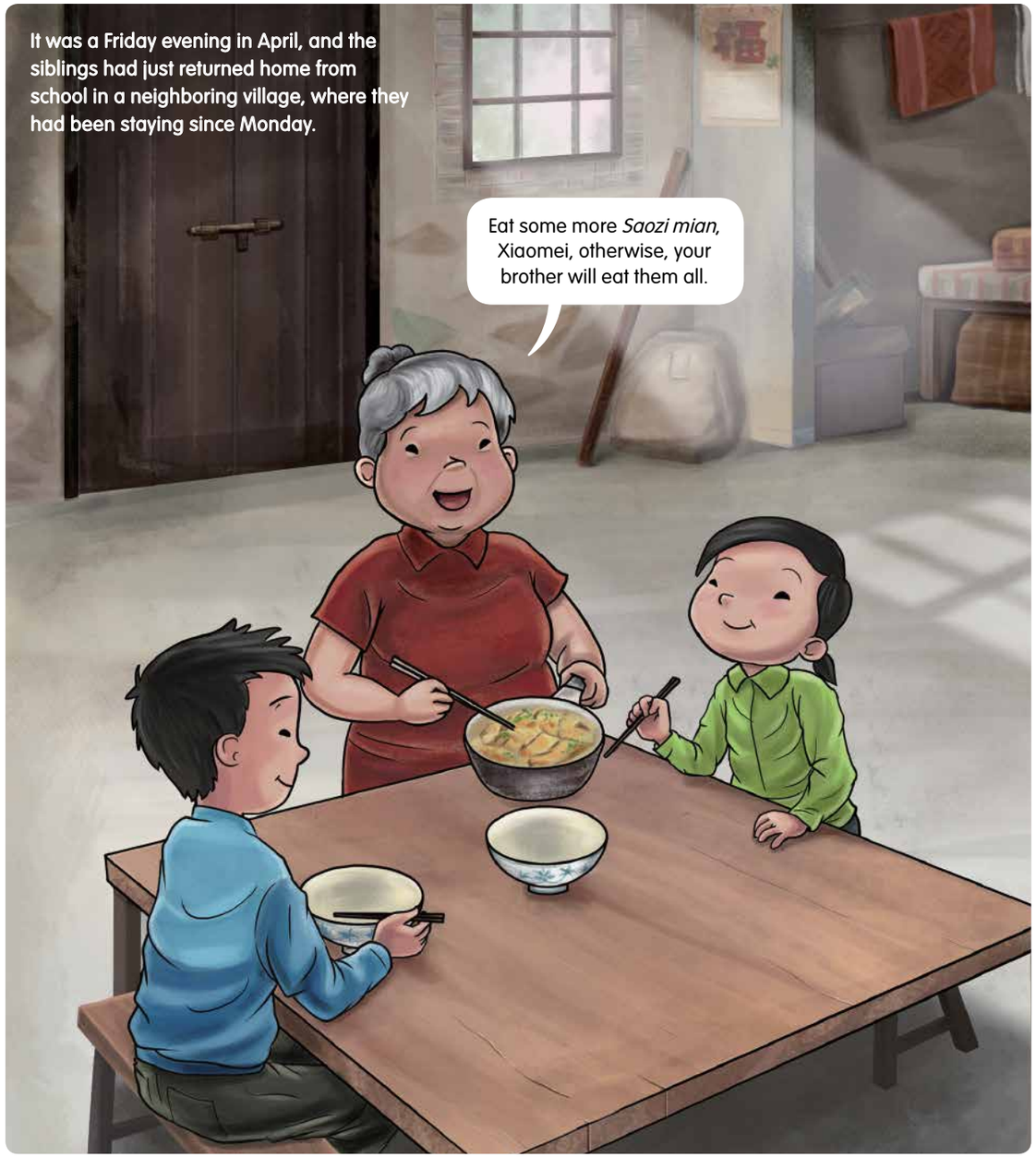
In his 30s, older son, works on a concrete crew for a construction company in Shanghai

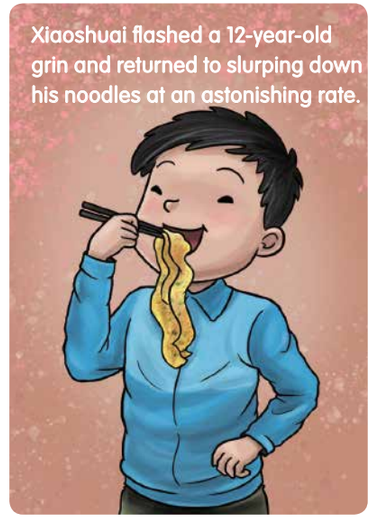
CHAPTER 1

The Best Noodles

TIME / Friday evening, April

PLACE / Xingfu Village, atop the Weinan tableland in Linwei District





That's just what I want to do in my old age ...

... feed a hundred children every day who eat like you two.

And besides, who would take care of the orchard?

Without your grandfather, it's just me and your uncle – when he can come up and help me a little bit.

Now that your father is in Shanghai building those tall buildings ...

... and your mother is serving people noodles at that restaurant down in Xi'an.

Why can't Ma come home more often, on the weekend, like she used to? I miss her and Pa so much!

Xiaoshuai shot his sister a cautioning look. He was old enough to notice the hint of sadness in Grandma's voice every time she had to answer that type of question, even though her reply was predictably cheerful.

Now, finish eating so that we'll have time to clean up before your father calls.

CHAPTER 2

Home is Far Away

TIME Friday 21:30

PLACE Xi'an and Shanghai

Ring... Ring...

Haiyan tapped her video call icon for the third time.

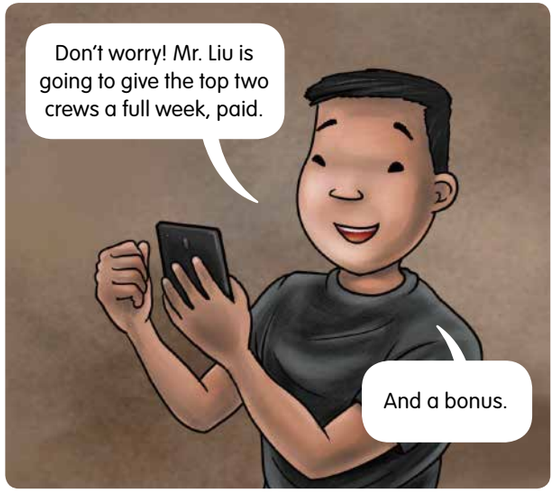
Ring... Ring...

Pick up the phooone, my break is going to be over in 10 minutes.

Hiiiii beee-yooouuu-teee-fulll

Jianguo's sense of humor didn't seem to diminish by what must have been a long day pumping concrete for the skyscraper his employer was building.

He had sent her a photo of the Shanghai construction site every day, taken at the same spot with himself in some silly pose.

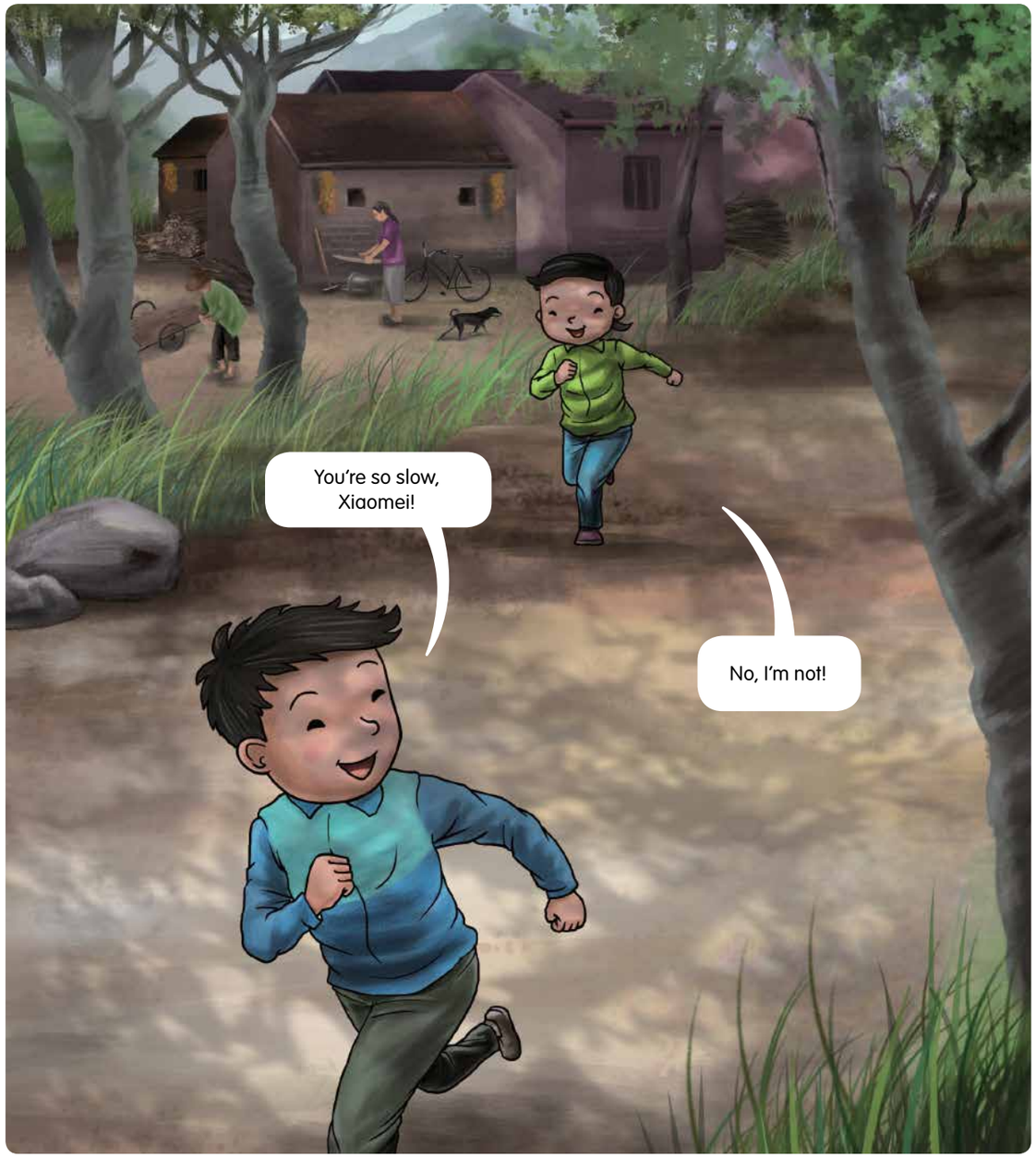


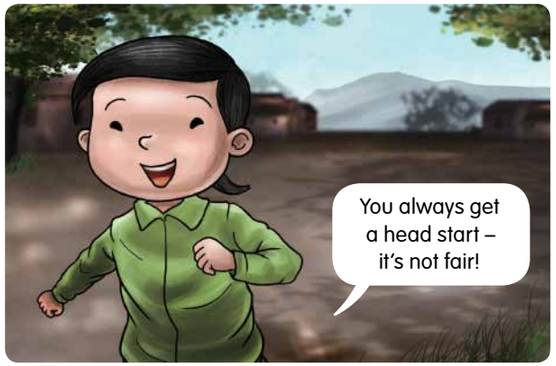
CHAPTER 3

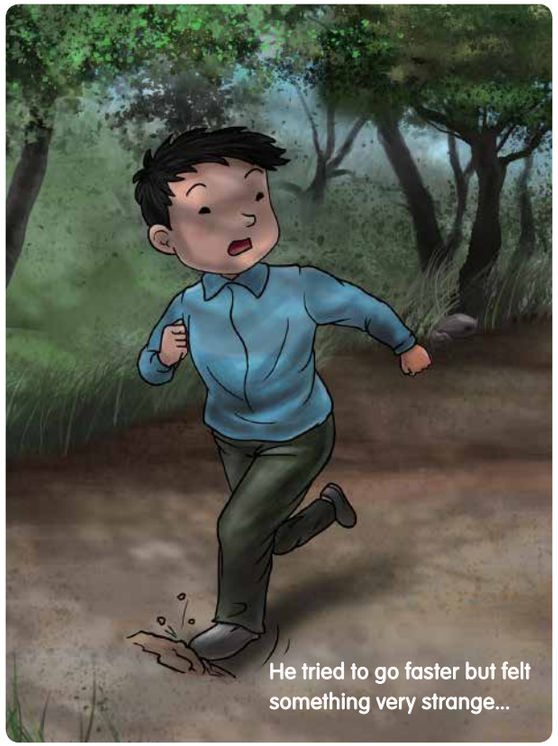
Earthquake!!!

TIME Saturday 14:02

PLACE Xingfu Village, atop the Weinan tableland in Linwei District







The Scenario Earthquake and Shaking Intensity Map

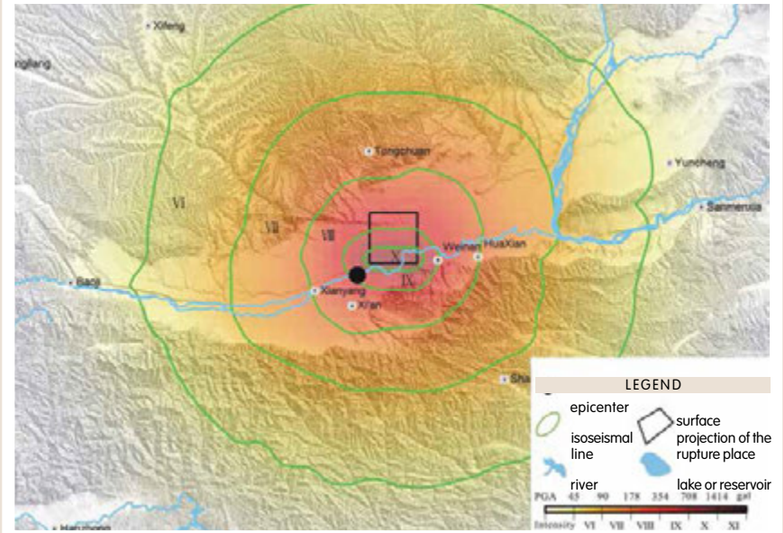
THE SCENARIO EARTHQUAKE

If the 1568 approximately M7 Gaoling (Northeast Xi'an) earthquake occurs today

TIME — At 14:02 local time on a Saturday in April

PLACE — Along the Weinan-Jingyang Fault on the west side of Linwei District, towards Xi'an

Earthquake Magnitude: Approximately M7



Shaking intensity map of a repeat of the 1568 approximately M7 Gaoling (Northeast Xi'an) earthquake.

At 14:02 local time on a Saturday of April, an approximately M7 earthquake occurs along the Weinan-Jingyang Fault on the west side of Linwei District, towards Xi'an. The earthquake ruptures the ground surface for 56 km. The north side of the fault moves downwards relative to the south side by more than 60 cm on average, and by more than 1 m in some locations [1]. This fault movement damages rail lines, roads, pipes, floodwalls, and buildings. Near the fault, the shaking is intensity IX to X, meaning that people riding bicycles fall down, many buildings are damaged and destroyed, and slopes collapse. Similarly strong shaking has been observed in past earthquakes of this type and size elsewhere in the world. In urban Linwei, the ground shakes strongly for more than 20 seconds.

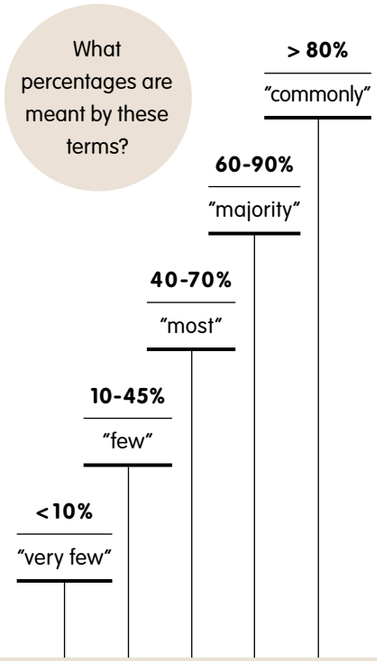
1 Yuan, T.H. & Feng X.J. (2010). *The 1556 Great Huaxian Earthquake*. Beijing: Seismological Press (in Chinese).

Earthquake Basics

THE CHINESE SEISMIC INTENSITY SCALE

Intensity	As experienced by people	Damage
I	Not felt	——
II	Felt by very few people indoors	——
III	Felt by a few still people indoors	Slight swing of suspended objects
IV	Felt by most people indoors, a few people outdoors; a few sleeping people awake	Obvious swing of suspended objects; vessels rattle
V	Commonly felt by people indoors, felt by most people outdoors; most wake up from sleep	Rocking or flipping of unstable objects
VI	Most people unable to stand, a few are frightened and run outdoors	Furniture and items moving; cracks in river banks and soft soil; occasional burst of sand and water from saturated sand layers; cracks on some stand-alone chimneys
VII	Majority of people frightened and run outdoors, felt by bicycle riders and people in moving motor vehicles	Objects fall from the shelves; river banks collapse; frequent burst of sand and water from saturated sand layers; many cracks in soft soils; moderate destruction of most stand-alone chimneys
VIII	Most people find it difficult to walk	Many cracks in hard dry soils; possible cracks and dislocations in bedrock; frequent landslides and collapses; collapse of many stand-alone chimneys
IX	Moving or standing people fall down	Many cracks in hard dry soils; possible cracks and dislocations in bedrock; frequent landslides and collapses; collapse of many stand-alone chimneys
X	Bicycle riders may fall; people in unstable situations may fall; sense of being thrown up in the air	Cracks in bedrock and earthquake fractures; destruction of arch bridge founded in bedrock; foundation damage or collapse of most stand-alone chimneys
XI	——	Earthquake fractures extend a long way; many bedrock cracks
XII	——	Drastic change in landscape, mountains, and rivers

What percentages are meant by these terms?



COMMON EARTHQUAKE TERMINOLOGY

Fundamental earthquake features

In China, earthquakes are described by their three fundamental features: the time when they occur, the location, and the magnitude.

Earthquake magnitude

Magnitude (M) is a measure of the energy released by an earthquake. The stronger the earthquake, the higher the magnitude. The energy released increases by 32 times from one magnitude unit to the next. For example, a M7 earthquake releases 32 times more energy than a M6 earthquake.

M3 & ABOVE People can generally feel an earthquake.

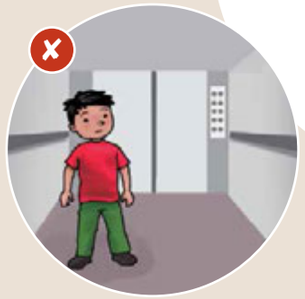
M5 OR GREATER Damages to buildings may occur. In China it is categorized as a "damaging earthquake".

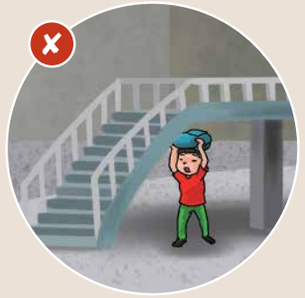
Earthquake intensity

Intensity expresses the strength of shaking from an earthquake at a specific location. It generally describes the level of damage an earthquake causes to buildings and lifeline infrastructure, ground rupture such as landslides and liquefaction, and effects on people. In China, there are 12 levels on the intensity scale.
The higher the intensity of an earthquake is, the greater the damage and harm it will cause.

How to Respond and Avoid Dangers When an Earthquake Happens

KEEP CALM





1 IF YOU ARE AT HOME WHEN AN EARTHQUAKE OCCURS

In a high-rise building

People in high rise buildings should quickly find a place to be safe from falling objects that are heavy or sharp. If possible, take cover under sturdy tables and beds, by empty corners of interior walls, beside fixed furniture, in bathrooms, etc. Drop down to avoid falling, protect your head and neck and make yourself small to help avoid being struck by falling objects.

MOVE CAREFULLY!

- Stay off balconies and away from windows from which you could fall or be struck by glass.
- Don't use elevators, even after shaking is over, because they could be damaged.
- Do not run downstairs with the crowd.
- Do not jump from floors above the ground level.

In a single-storey building

As soon as possible, or once strong shaking stops, people in single-storey buildings should go quickly to an open space outside, away from buildings that may fail or shed debris. In the midst of very strong shaking, it is best to take cover beneath a strong table, by a Kang (Chinese rural brick bed with integrated furnace underneath for heating), or by an interior corner. Try to use materials at hand to protect your head, such as pillows or a wooden cutting board.

Wherever you find yourself in an earthquake

- Stay calm and think first, because running carelessly can put you in danger.
- Protect yourself from suspended ceilings, pendant lamps or other objects that can dislodge and hurt you.
- Avoid unfixed furniture that can move and injure you.
- Wait to go back into buildings for any purpose, because an aftershock may cause further damage that could trap you.
- Keep a distance from weak buildings, walls, parapets, and decorative protrusions, because these may still fail and cause harm.

2 IF YOU ARE OUTDOORS WHEN AN EARTHQUAKE OCCURS

KEEP CALM

- Go to an open space, away from anything that could fall on you. Get low or crouch down. Stay away from buildings and structures, because they could collapse, or objects could fall from the exterior and injure you.
- Stay away from glass walls, tower cranes, chimneys, water towers, and other high structures. These could break or fall.
- Stay away from power transformers, utility poles, power lines (especially broken lines), street lights, advertising signboards, etc. These might carry live voltage.
- Stay away from places where poisonous, inflammable or explosive substances are stored.
- Stay away from narrow streets, masonry houses and walls, tile roofs, wood piles, etc. These could fall on you or trap you.
- Stay away from flyovers, overpasses and any type of bridges and tunnels. Damages to these structures could block your route or trap you.
- Stay away from steep slopes and cliffs (such as loess tableland edges), as well as stream valleys, because an earthquake can trigger rock slides, landslides, mud slides and other secondary hazards. Be watchful near riverbanks, because an earthquake can cause an upstream dam to break.

In case of rockfall, landslide, etc., run across in the direction perpendicular to rolling stones or moving slopes (not downhill), or cover under objects that are solid enough, and protect your head.

3 IF YOU ARE IN A CROWDED OR DENSELY POPULATED PLACE WHEN AN EARTHQUAKE OCCURS

- Follow staff's directions.
- Evacuate quickly if you are near an exit.
- If you cannot evacuate quickly, stay away from crowds rushing to exits, and look for shelter as quickly as possible.
- If you are already in a crowd, cross your arms over your chest and protect your space using your shoulder and back.
- If you cannot get out of a crowd, pick up your feet while walking to avoid tripping and move forward with the crowd, try to not fall down, and do not try to go the opposite direction.
- Avoid causing a stampede.

If you are in your office

Quickly take cover under a sturdy office table or next to a cupboard fixed to the wall. Hold on to something (table leg, etc.) so that you move with the protective item, or squat down by a corner wall; try to turn off power switches.

If you work at a restaurant or factory

It is very important that employees quickly put out open flames, turn off power, and close valves of flammable, explosive, or poisonous gases first, and then evacuate or take cover as soon as possible. This is to prevent fires, which can rage uncontrolled after an earthquake.

TIME / Saturday 14:05

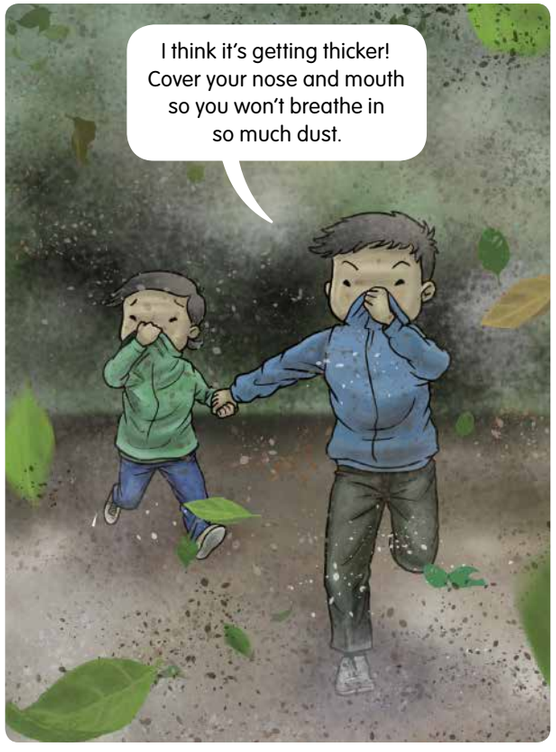
PLACE / The restaurant in south Xi'an

CHAPTER 4

Where is Grandma?

TIME / Saturday 14:06

PLACE / Xingfu Village, atop the Weinan tableland in Linwei District



Through the dimness, Xiaoshuai could just make out the outline of their house. Or was it? It was a strange shape, as if the corner had been sawn off by a giant hand, and the tall roof wasn't as tall and straight anymore. As they came closer, they could see roof tiles lying in heaps on the ground.

They saw large cracks in the walls and stopped short, fearful of going closer.

Grandma! Grandma! Where are you?

Grandma?

Grandma?

Grandma?

We're here, we're okay. There was so much dust we could barely see on our way home.

Nngh ~

Xiaoshuai ~

Grandma? Grandma?

Nngh ~

Grandma! That's her! I think she's somewhere inside.

She's underneath that brick pile. There!

We have to get her out before there's an aftershock.

Ouch... Help... Nngh ~ Nngh ~

Grandma, we're going to get you out.

No, Xiaoshuai! Those bricks will fall on you.

Go get Mr. Zhang to help. Run fast.

Grandma, I'm going to get you out.

Cover your nose and mouth with a cloth, for example your sleeve or shirt, to avoid inhaling dust. Building collapses and landslides may produce heavy dust, especially in the loess areas.

If you are near a chemical plant or other sources of poisonous gas and poisonous gas is leaking, take refuge immediately in a higher place in the upwind direction. Cover your nose and mouth with a wet cloth or towel.

Cover your nose and mouth

SURVIVAL TIP

How to Help Find People Trapped in Houses

Based on the experience of recent earthquakes in mainland China, the five-steps "Ask, listen, observe, search, shout" proved effective to find people who are trapped in collapsed houses or other buildings.

Shout

Engage family members, friends, and acquaintances to call the name of the trapped person.

Ask

Find out how many people are trapped; ask if family, friends or acquaintances were nearby when the earthquake occurred, and their possible location.

Search

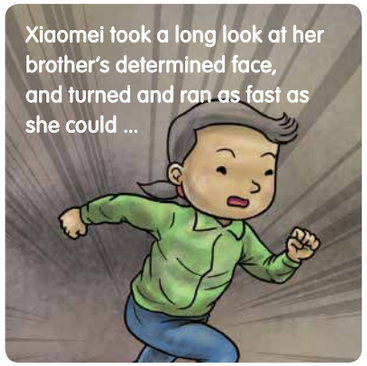
Look for trapped people between gaps in rubble or behind obstacles.

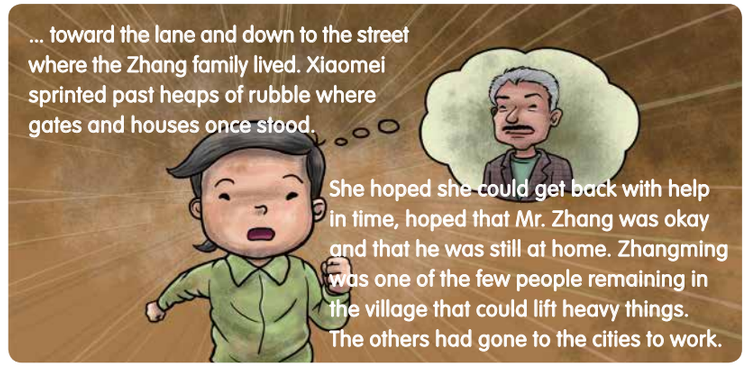
Listen

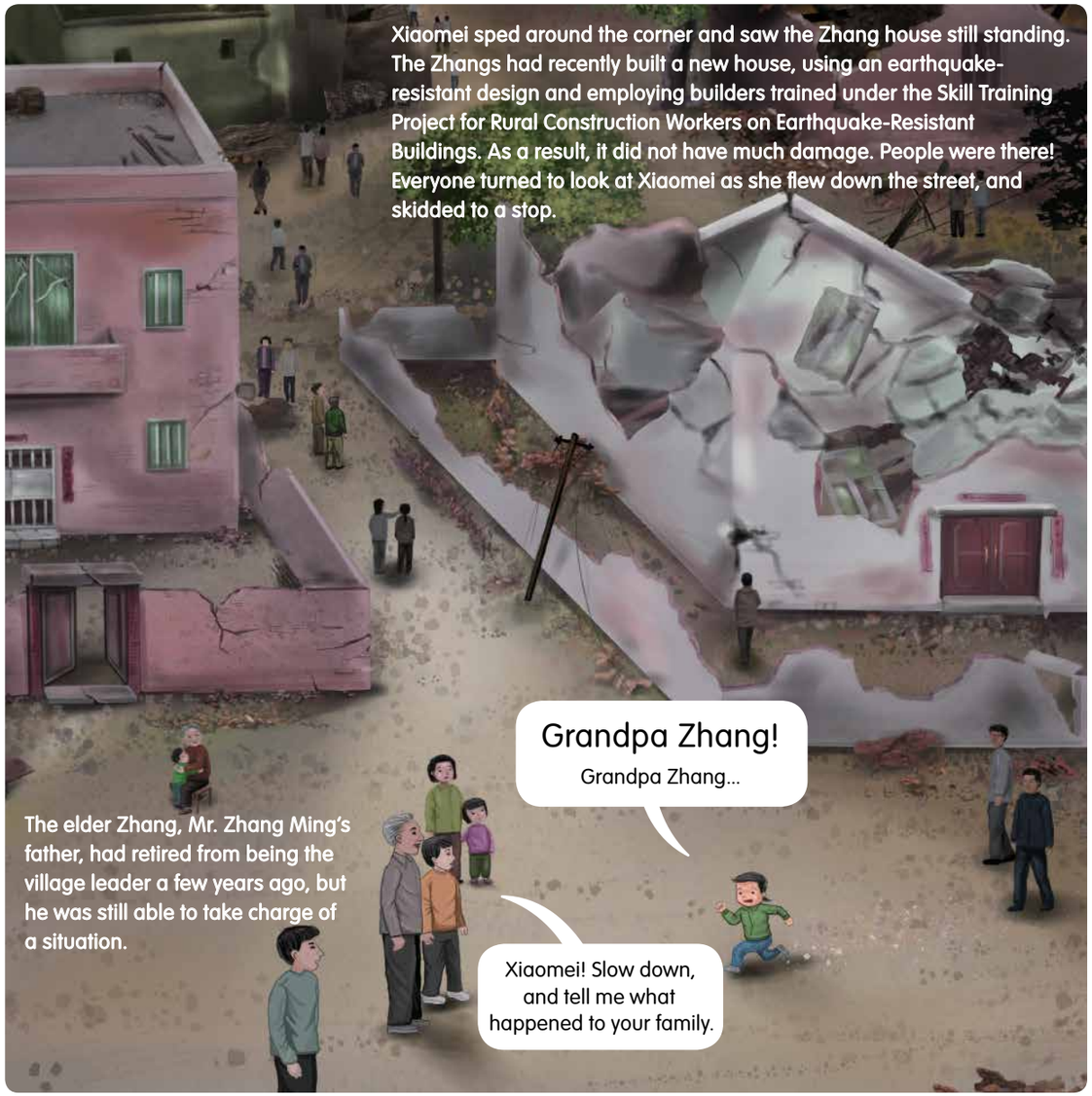
Be very quiet so you can hear sounds that a person may make, such as a call for help, a moan, or tapping.

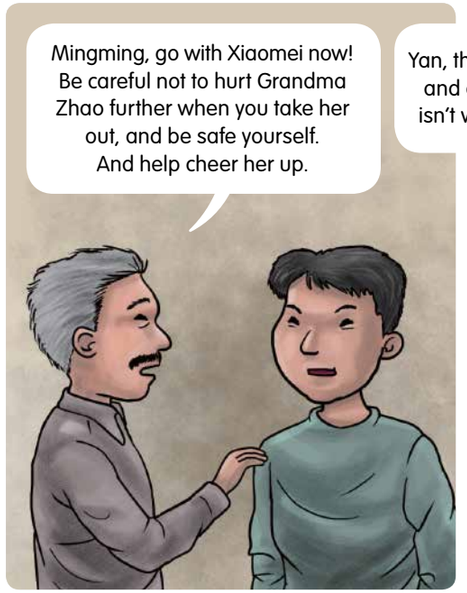
Observe

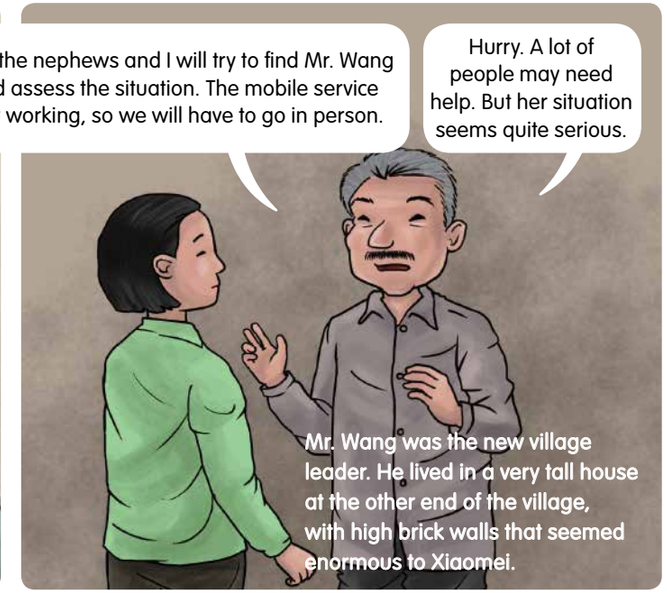
Check for limbs sticking out, blood stains, clothes or other signs.









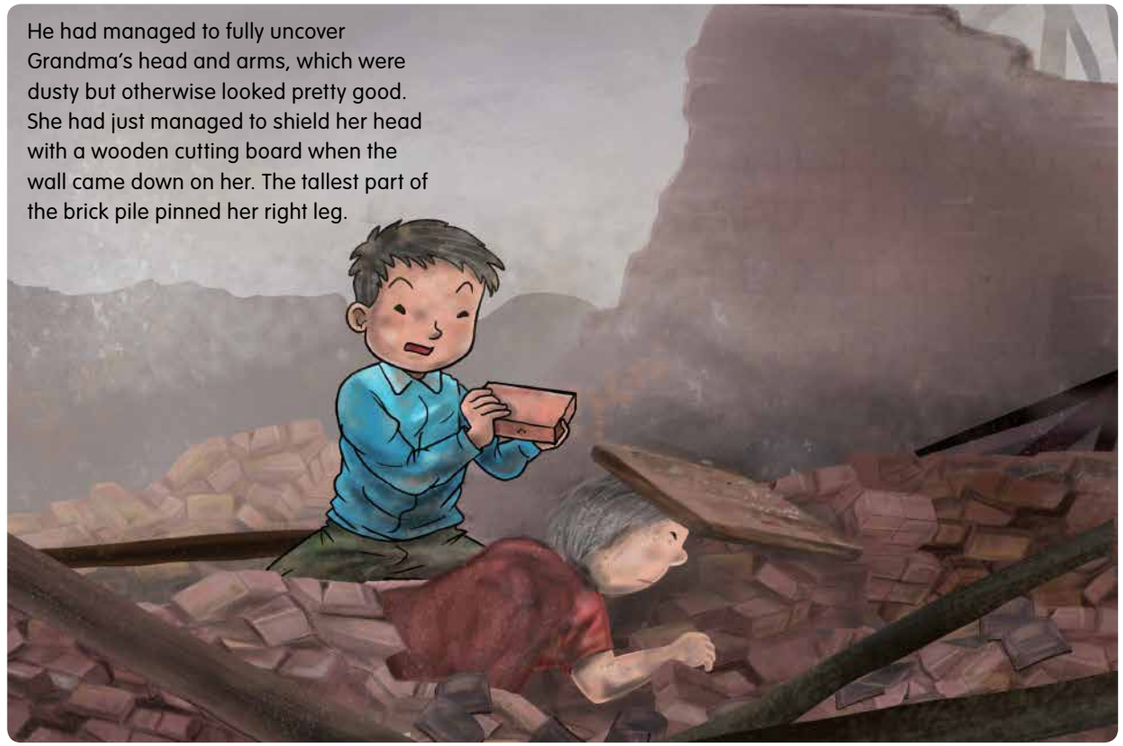


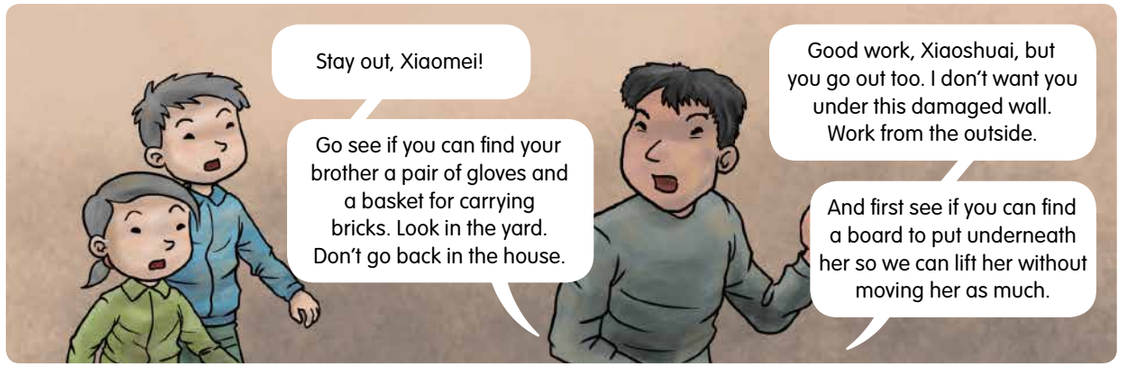
CHAPTER 5

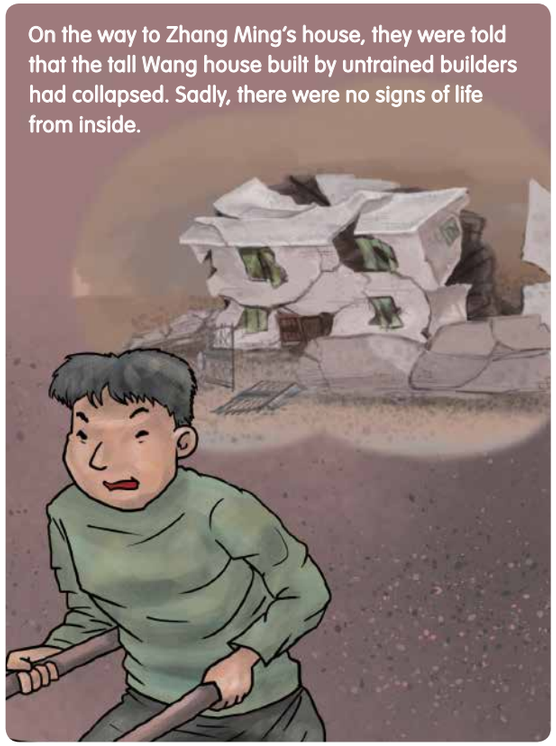
The Community Helps Each Other

TIME Saturday 14:43

PLACE Xingfu Village, atop the Weinan tableland in Linwei District







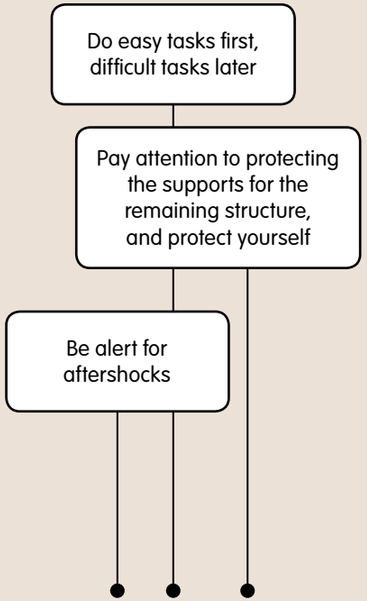
Rescue Priorities

1 QUICK & TIMELY RESCUE

Do easy tasks first, difficult tasks later. Save the living first, bring out the dead later. In this scenario, Xiaoshuai first removes the rubble near his Grandma's head to make sure that she can breathe well.

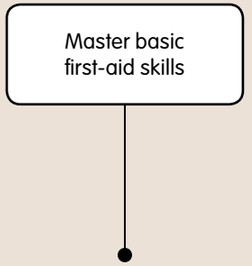
While digging out trapped people, rescuers should protect the supporting structure to avoid new collapses. This avoids further injuries to trapped people and protects rescuers. Be aware of dangerous houses and walls that have not collapsed completely.

Be alert for aftershocks. In this scenario, Grandpa Zhang tells Zhang Ming, who is going to help grandma, "be careful not to cause further injuries to grandma, and be safe."



2 AFTER THE RESCUE

After rescuing a trapped person, check for injuries and treat promptly. Treatment will require a person who is trained in basic first-aid skills, such as wound cleaning and dressing, fracture treatment, and artificial respiration.



SETTLEMENT

TEMPORARY SHELTERS

When arranging temporary shelters for disaster victims:

- Avoid dangerous houses / walls, chimneys, water towers, power lines (especially high-voltage power lines), and other dangerous zones / items.
- Avoid dangerous cliffs and abrupt.
- Avoid traffic crossing and roads.
- Strictly prohibit open flames.
- Protect the environment and prevent the spread of diseases.

Cover your head and neck with your hands or with materials, such as a pillow or schoolbag. Keep your head low if possible, close your eyes to keep out dust and debris.

In this scenario, Xiaoshuai's grandma protects her head and neck with a board, and may have saved her own life.

There are **71.52** million m^2 of buildings in total in Linwei and Huazhou.

If the 1568 approximately M7 Gaoling (Northeast Xi'an) earthquake occurred in the present day...

ESTIMATION

Scenario Earthquake
1568
Gaoling (Northeast Xi'an)
Approximately M7

Building Damage

URBAN AREAS

Urban parts of the two districts: 45.18 million m^2 buildings (62,800 individual buildings) exist.

Moderate to severe damage

23.08 million m^2 buildings were estimated to suffer moderate to severe damage. Percentage of the total area of buildings in urban parts:

51.1%

Collapsed buildings

About 1.89 million m^2 buildings collapse. Percentage of the total area of buildings in urban parts:

4.1%

If the 1568 approximately M7 Gaoling (Northeast Xi'an, earthquake occurred in the present day, **rural areas in western Linwei district would suffer very strong shaking and the heaviest building damage**.

Damage to rural houses after an earthquake

RURAL AREAS

Rural parts of the two districts: there are 26.34 million m^2 buildings in total.

Moderate to severe damage

10.42 million m^2 buildings were estimated to suffer moderate to severe damage. Percentage of the total area of buildings in rural parts:

39.5%

Collapsed buildings

An estimated 1.57 million m^2 buildings collapse. Percentage of the total area of buildings in rural parts:

6.0%

In rural Linwei area, there are 16.77 million m^2 of buildings, and almost all of them are either brick-wood (28.7%) or brick-concrete (70%) type, according to the commonly used Chinese building type classification.

In the scenario earthquake shaking, nearly 1.33 million m^2 of these buildings collapse, taking up 7.9% of the total building area in rural Linwei. A further 7.27 million m^2 suffer moderate to severe damage, or 43.4% of the total buildings of rural Linwei.

Most of these rural buildings are self-built by owners, and not constructed to any building code or with earthquake-resistant features.

LINWEI & HUAZHOU DISTRICT TOTALS

Moderate to severe damage

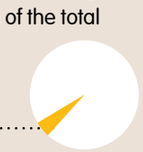
More than 33.5 million m^2 of buildings were estimated to suffer moderate to severe damage. Percentage of the total area of all buildings:

46.8%

Collapsed buildings

About 3.46 million m^2 of buildings collapse. Percentage of the total area of all buildings:

4.8%



Unreinforced masonry buildings, like the Zhao family's home and the new village leader Mr. Wang's house in the story, suffer the most damage.

In urban Linwei, small commercial and older residential masonry buildings suffer heavier damage. Many of these buildings were built before modern earthquake-resistant codes. Even in the comparatively newer buildings, the decorations and partition walls might be damaged and required to be repaired in a short time after the earthquake. Huazhou district is farther from the earthquake fault, so the shaking is not so strong as the one in Linwei. There is less damage in Huazhou.

Landslides

Weinan tableland: Earthquake shaking triggers about 100 to 150 landslides in the Weinan tableland. These are concentrated along the tableland edges and in its incised valleys, particularly in the northern and western parts. In an instant, the deceptively stable-looking loess – a wind-deposited soil – loses its strength, and falls quickly into roads, the expressway, rail lines, and the You He reservoir. Landslides rupture gas lines, slice through roads, and carry away buildings.

Huashan mountain front: To the east along the Huashan mountain front, smaller rock slides and rockfalls affect railway tracks, fields, and mountain roads.

Southern and eastern mountain areas: Up to 700 additional smaller landslides of one hundred to one million m^3 in volume occur in the steep mountain areas south and east of Weinan's urban areas. People in villages or traveling by road and rail are caught in landslides, and some are injured or killed.

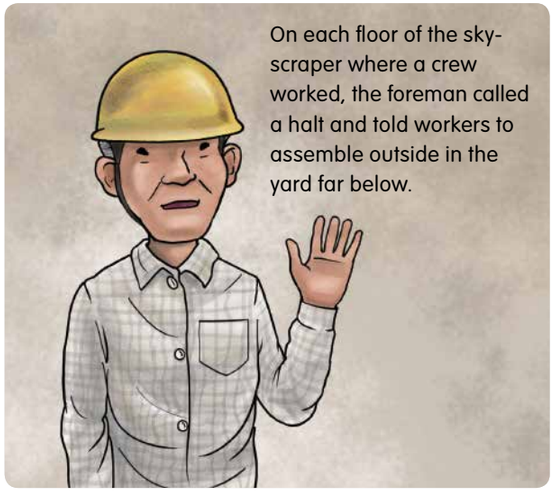
Aftermath: In subsequent months and years, landslide debris will wash into streams, which creates debris flows, chokes channels with sediment, and increases flooding. Heavy rains trigger further landsliding on weakened hillsides. Unsafe cuts into a slope can make the slope unstable and creates risk for a later landslide. If you live in the loess plateau or mountains, get help from a geologist and follow excavation regulations before building on a slope.

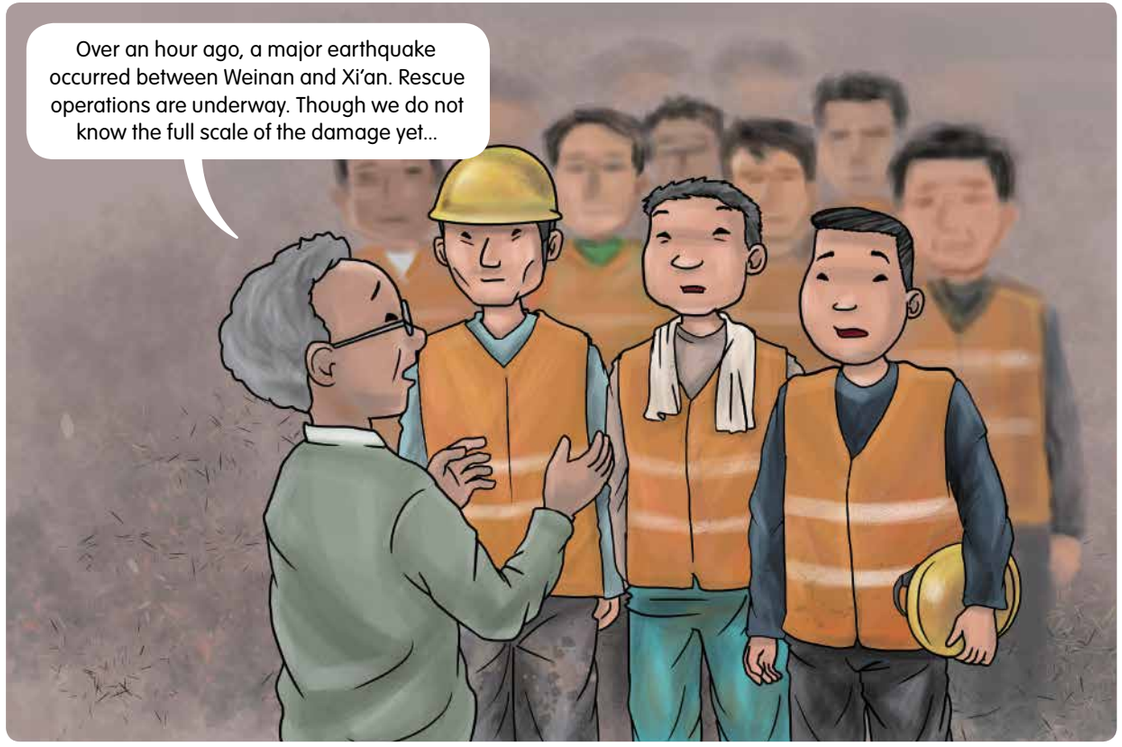
CHAPTER 6

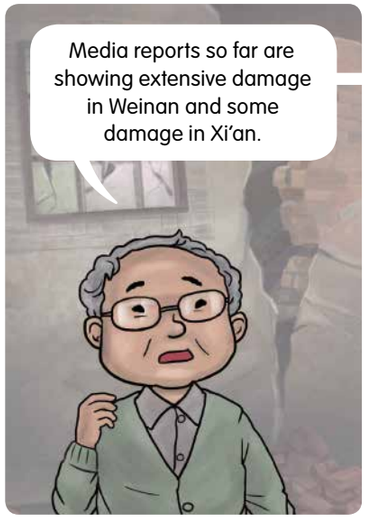
Rushing Home – Jianguo

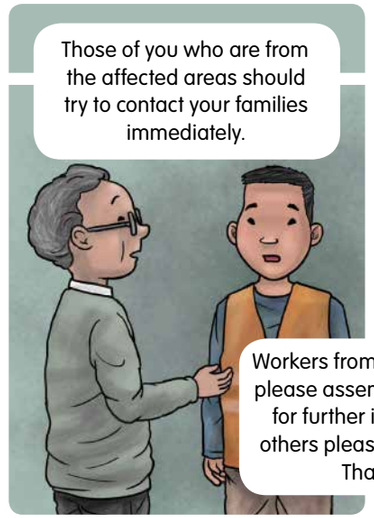
TIME 15:30 Saturday afternoon

PLACE A construction jobsite for a new skyscraper in Shanghai









Jianguo, Zhou and Ma started the 14-hour drive on interstate G40 – the straight-arrow route to Xi'an – direct from the jobsite. They rotated driving duty, obsessed over the tiniest bits of news from WeChat, and tried to call and message their families.

No one got through to relatives in Xi'an for almost three hours due to system overload, and they couldn't reach Weinan at all.

CHAPTER 7

Rushing Home – Haiyan

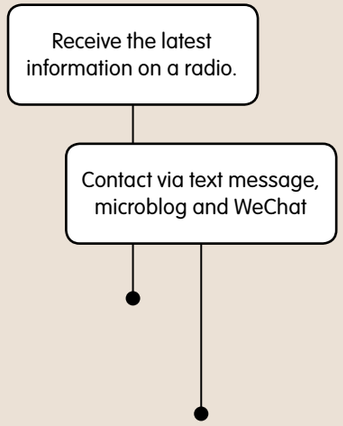
TIME 16:30 Saturday

PLACE Around a restaurant in South Xi'an

Disaster Preparedness and Response Tips

FAMILY EMERGENCY KIT

An earthquake interrupts water supply, power, and transportation systems. Prepare to be self-sufficient for a period. Store some emergency supplies, such as food, bottled water and emergency clothes; essential medicines; a basic first aid kit with drugs and supplies to prevent and treat common minor injuries and diseases, masks, etc.; flashlights, lighters / matches, candles etc.; portable radios and batteries; whistles; work gloves, ropes and small multi-purpose tools.



MAKE AS FEW CALLS AS POSSIBLE AFTER AN EARTHQUAKE

— Make as few calls as possible after an earthquake to avoid telephone network congestion; receive the latest information on a radio.

— Send a few short text messages rather than calling family and friends. You are more more likely to get through because text message, microblog and WeChat take far less bandwidth.

— Use text message, WeChat and microblog to free up communication networks for rescue team and emergency calls.

Haiyan gave up after four tries to Grandma's phone and three to her brother-in-law Jianjun. She messaged Jianguo that she was okay. Jianguo responded immediately...

On my way. There in 10 hours.

Haiyan did a quick mental calculation, trying not to cry in front of a stranger. Even at a time like this, she had to watch expenses. Paying for her father in-law's medical treatments had put them deep into debt.

Can you please let us pass? She lives up on top of the tableland and needs to get home to her children.

This road is closed. I have orders not to let any civilians through, especially at night.

Please, sir, my children and mother-in-law are up there and I can't reach them. I've called and called. Please.

It's not safe to drive it at night, ma'am. The road has cracks everywhere and parts of walls and power lines fell down into it.

And there are some unstable sections. We aren't even permitted to drive it after dark.

We have to go back to Xi'an tonight. If I'm feeling lucky, we can try again tomorrow.

The road to Weinan is closed. I can only go back to Xi'an. My phone is going to die.

Be safe. Call me soon.

Okay.

After several hours struggling to get back to Xi'an, Haiyan wearily got off the back of the bike in front of her apartment.

Thanks for trying so hard to help me get home today. Could you take me again early tomorrow morning? Please?

Sure! Message me the time you want to go … and stay safe tonight.

The power was back on, and it seemed everyone decided it was safe enough to go inside for the night. Good thing, because it was starting to rain.

She dropped her bag on the apartment floor, plugged in her phone, and called Jianguo.

CHAPTER 8

Waiting for Morning to Come

TIME 05:30 the morning after the earthquake

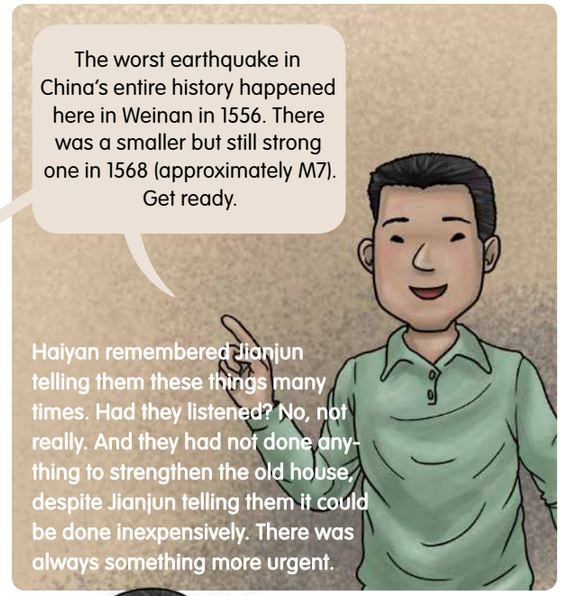
PLACE South of Xi'an

Haiyan rose before dawn to meet Jianguo at a petrol station beside the G40 expressway southeast of Xi'an, as they had planned the night before.

On the G40, a seemingly unending line of heavy transports streamed past, bearing soldiers and relief supplies bound for the earthquake zone. Over ten years ago, Jianguo's younger brother Jianjun was on a transport like that, headed for the areas hit by the 2008 Wenchuan earthquake. Watching them, Jianjun's words came rushing back to Haiyan's mind.

The best thing is to make your house earthquake-resistant. The army can't help if your house falls down and kills you.

The worst earthquake in China's entire history happened here in Weinan in 1556. There was a smaller but still strong one in 1568 (approximately M7). Get ready.



Haiyan remembered Jianjun telling them these things many times. Had they listened? No, not really. And they had not done anything to strengthen the old house, despite Jianjun telling them it could be done inexpensively. There was always something more urgent.

But they would listen now, Haiyan resolved. Actually, she was quite sorry that they had not taken Jianjun's advice seriously before the earthquake.

A small truck in the long line parted from the stream and pulled off at the station. In a moment, Jianguo was there. Neither spoke for a long minute.

Zhao's brother was coming to take Mr. Zhao and Mr. Ma to their village in north Linwei, across the Wei River. It would be a long journey because they had to go around to the east and north to avoid closed-off bridges, across or near the Wei River, in the areas most affected by the earthquake.

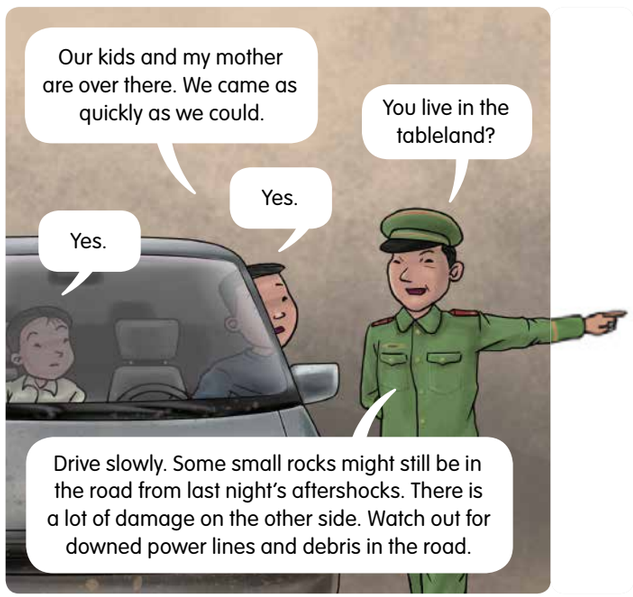
Massive cracks had opened as land near the riverbanks slid toward the river. This damaged the roads up to the bridges.

The G30 expressway was closed just east of Xi'an so that engineers could inspect the Bahe bridge. Zhou's and Ma's families had been outside during the earthquake and were okay. But there was damage to the houses, and the ground had settled unevenly in places.

With the truck refueled, Jianguo and colleagues wished each other well.

Then, Jianguo and Haiyan drove back along the G40 eastward, heading for home.

Past Houzhen, on the south side of the hills, they saw a checkpoint ahead. Haiyan's countenance dropped.



CHAPTER 9

Ma and Pa are Back!

TIME 10:50 the day after the earthquake

PLACE Xingfu Village, atop the Weinan tableland in Linwei District

Haiyan and Jianguo dashed around to the back of the house, and saw the gaping hole in the back corner. It appeared there had been a rescue of some sort – bricks were piled in odd spots, and boards of different lengths and sizes lay about. Someone had been underneath all those bricks.

Haiyan couldn't breathe for a moment.

They are going to be okay. They are going to be okay, Haiyan. Maybe they're at the Wang or Zhang house. Let's go.

Jianguo and Haiyan arrived at the elder Mr. Zhang's house first. Whenever anything major happened, people gathered there.

I know you must have been so worried, but Xiaoshuai and Xiaomei are safe! I sent them to stay last night with great-uncle. I am sorry to say that your Ma was badly injured, and I sent her to the nearest township-level hospital.

Your Ma may have been transferred, to a larger hospital, but I'm not sure.

Oh, thank goodness, my children are safe!

After hearing this news, Haiyan and Jianguo rushed to the home of Jianguo's great-uncle.

Brrrmm ~

Brrrmm ~

Ma! Pa!

Brrrmm ~

Xiaomei heard the motor of a truck and familiar voices.

Xiaoshuai, it's Ma and Pa!

Both children shot out of the courtyard.

You came! Both of you!

Ma! Pa!

You came all the way from Shanghai! I wish you were here yesterday to help rescue people.

My children are little heroes! And I wish I could have helped ... I came as soon as I could, right from the jobsite. It takes 14 hours to drive all that way.

Mr. Zhang and I had to take a huge pile of bricks off of Grandma's leg...

Her leg was broken! Xiaomei ran to get help.

I tried to come all yesterday afternoon and evening... Now we're here together, and more important, you both are safe!

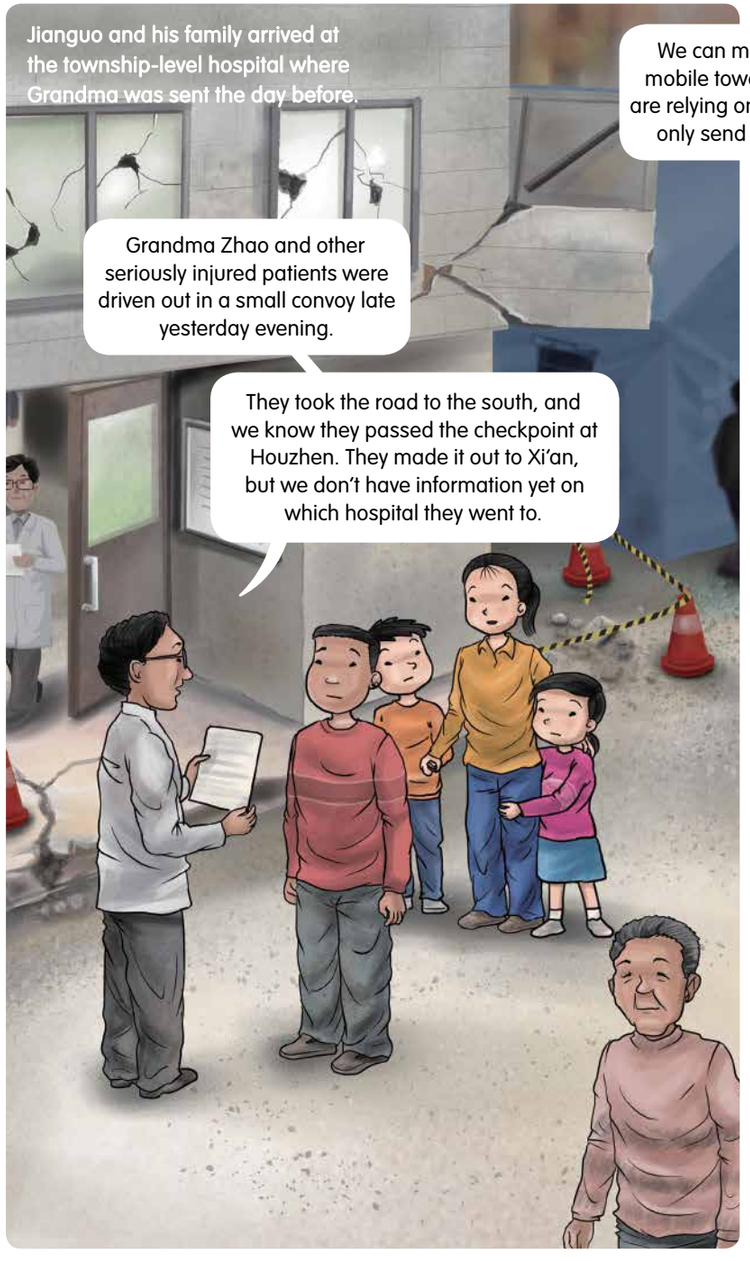
And now we're going to all go together and see Grandma.

CHAPTER 10

Looking for Grandma in the Hospital

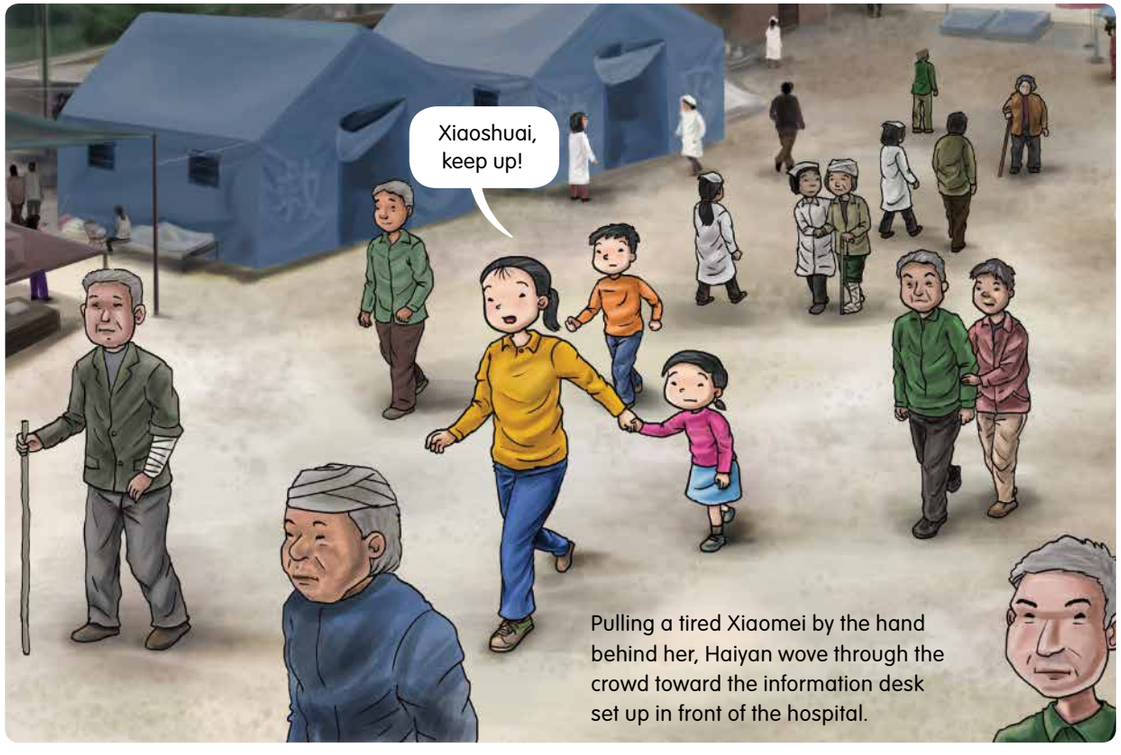
TIME 12:00 the day after the earthquake

PLACE A local township-level hospital on the Weinan tableland



TIME 18:30 the day after the earthquake

PLACE Wei Min Hospital in Xi'an



Not knowing what she would hear, Haiyan left Xiaoshuai and Xiaomei by a parking lot sign, safely out of earshot of the information desk, with strict instructions not to move.

Finally making it to the desk, she gave Grandma's name to the young woman working there.

Zhao Mei. I don't see that name here on either the inpatient or the other lists. Are you sure she was brought here?

Yes, last night from Linwei District of Weinan city, up on the tableland. There were six badly injured elderly people, five women, one man. They were unsure of some names. Two didn't survive the trip.

Let me check again, there should be some information for a group that size.

Two women from this group are in the ICU, and one is in Trauma. In the file it says there is some uncertainty about their names.

I'll get a volunteer to take you up. I hope one of them is your mother-in-law.

Xiaoshuai kept praying silently that Grandma would be okay, especially after she was not in the ICU. Frustratingly, it seemed all he could do today was wait, ride in the truck, and wait some more...

A nurse's call broke into Xiaoshuai's thoughts.

Zhao Mei's family, please come this way.

The nurse led them down a hall and to a small room.

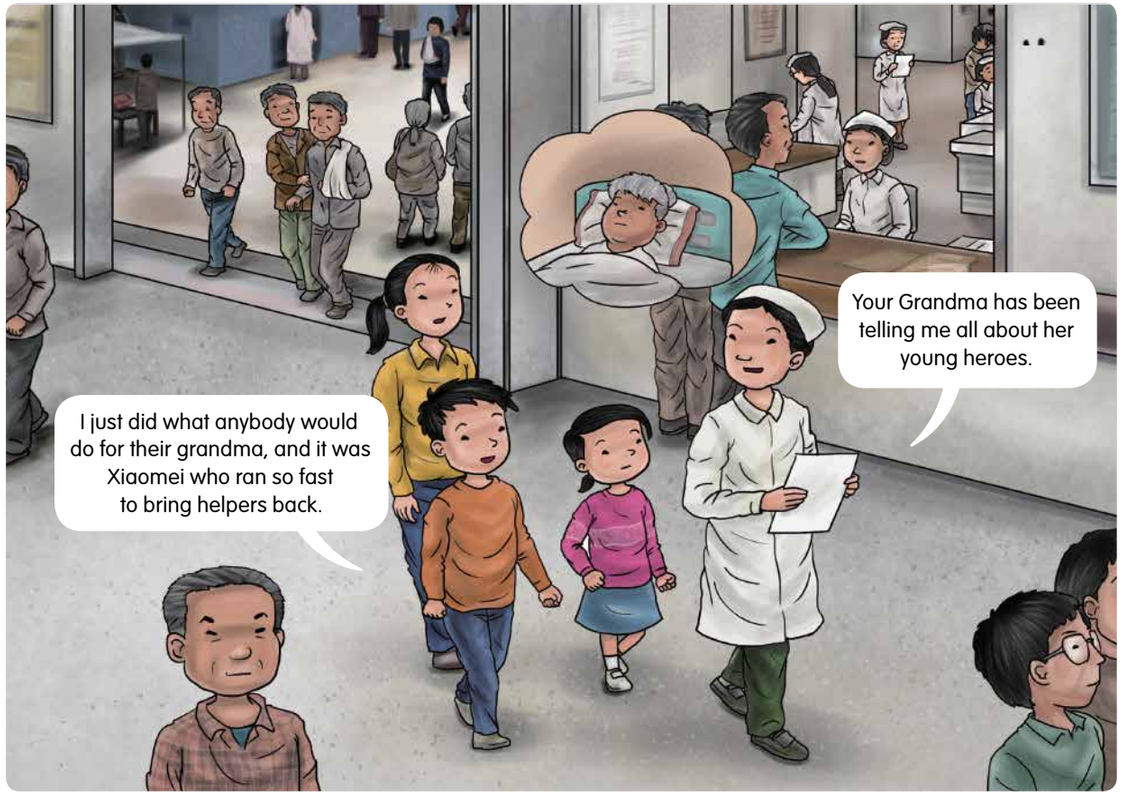
Grandma!

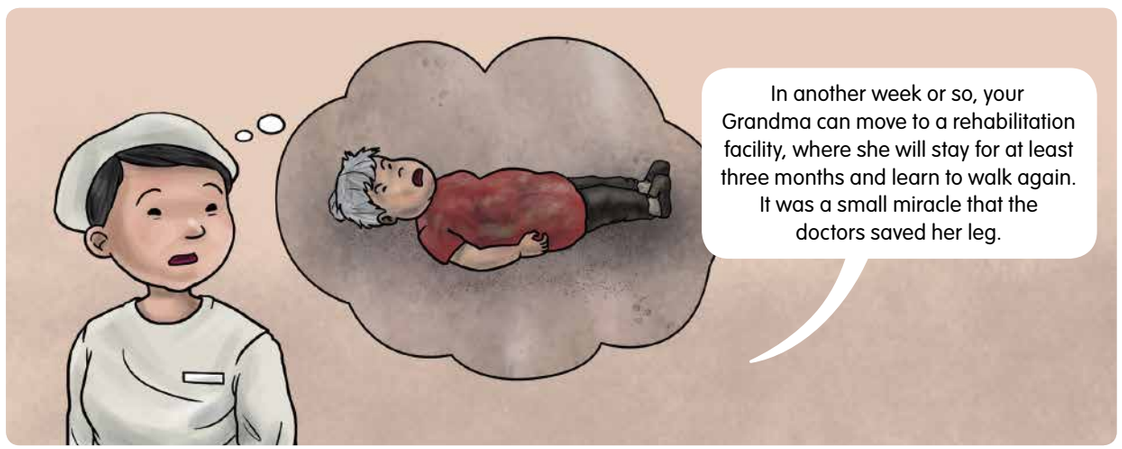
CHAPTER 11

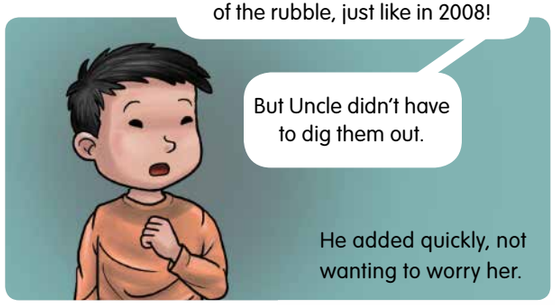
Uncle Jianjun's New Earthquake Story

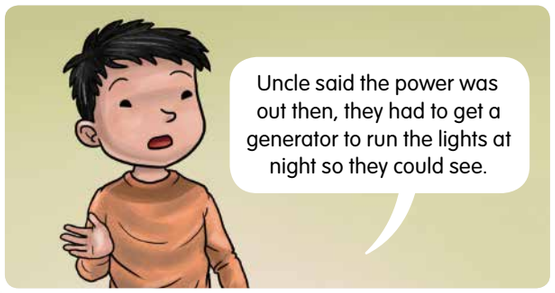
TIME One week after the earthquake

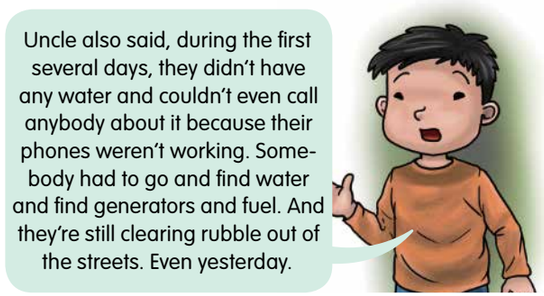
PLACE Wei Min Hospital in Xi'an

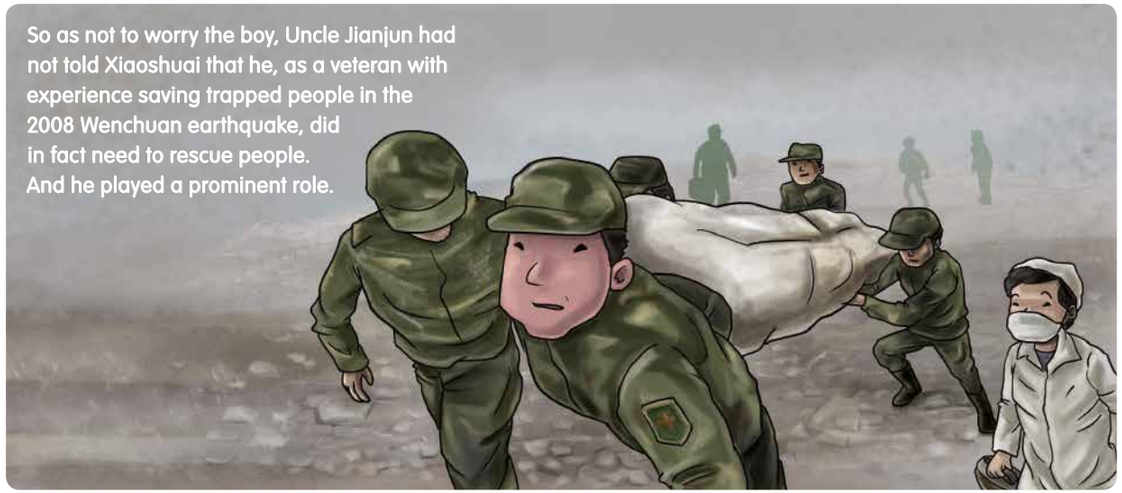


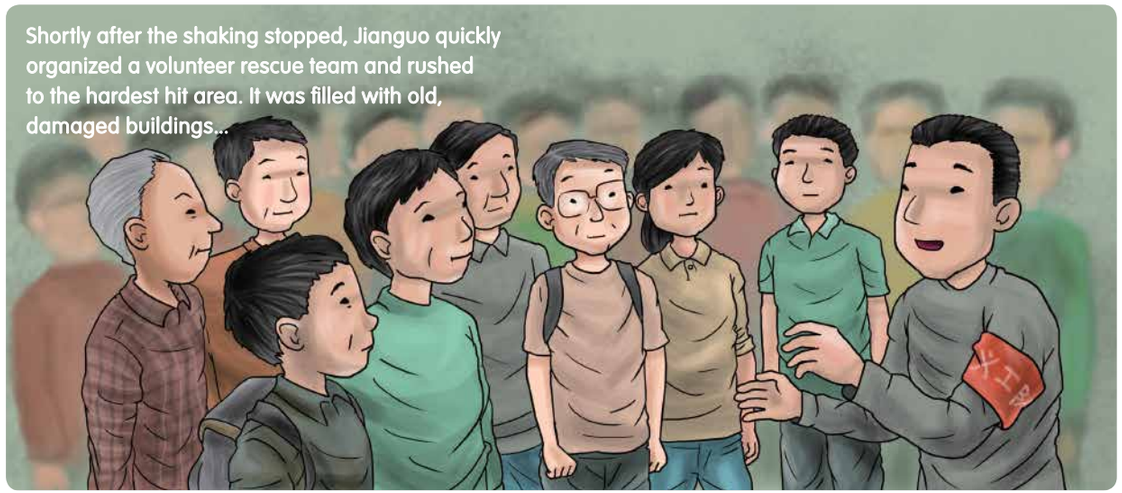


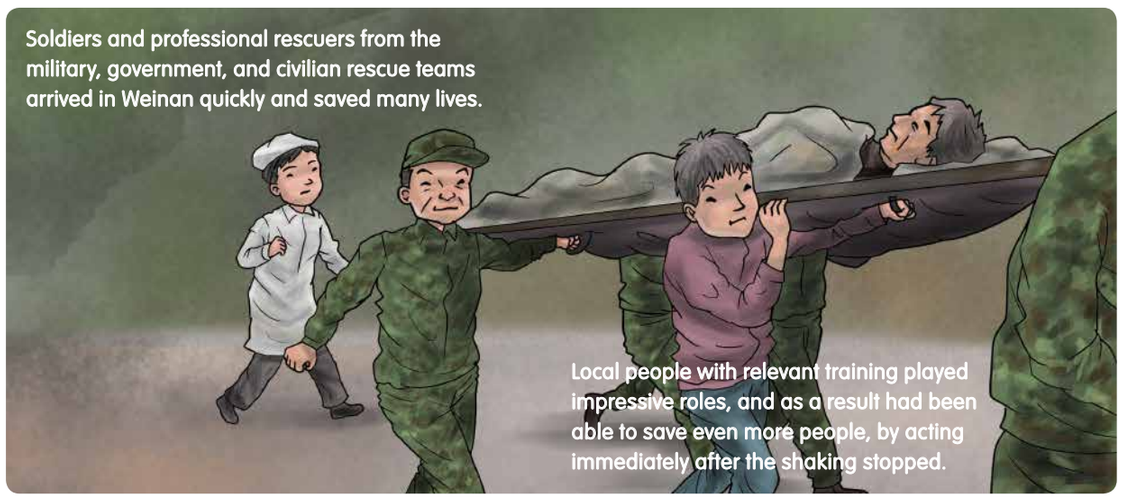










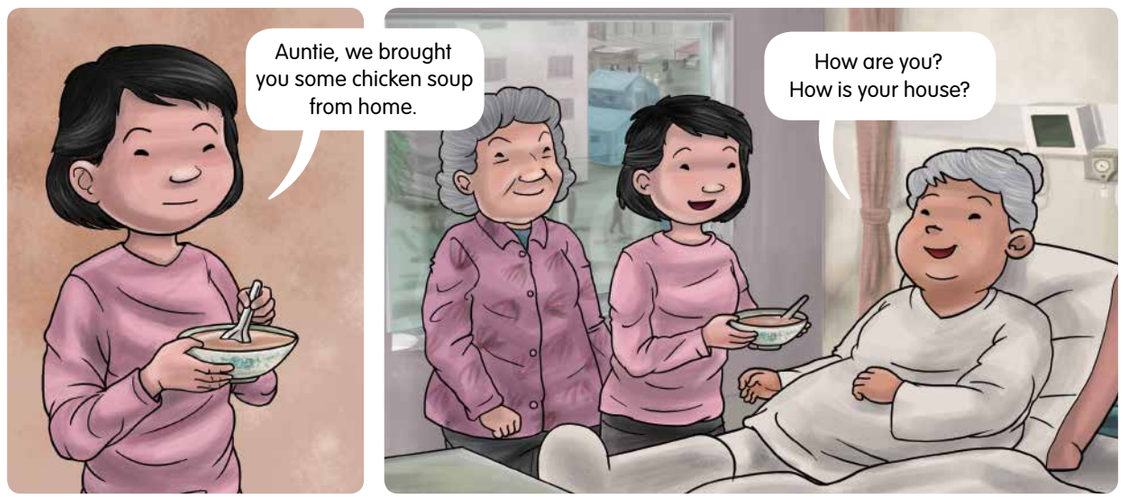


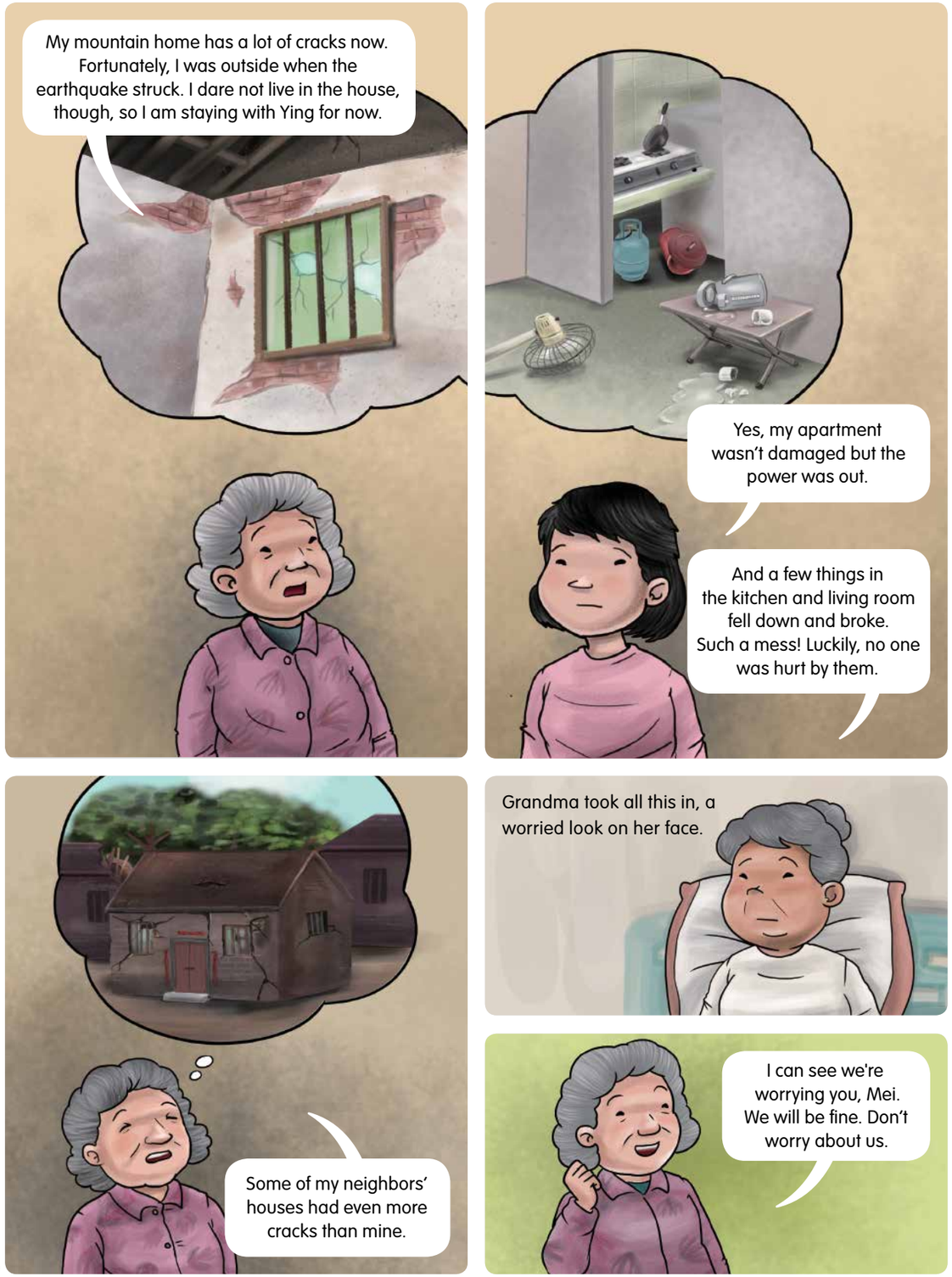
CHAPTER 12

Homemade Chicken Soup

TIME Two weeks after the earthquake

PLACE Wei Min Hospital in Xi'an





Learn Earthquake Safety

Protect yourself and your family against indoor earthquake dangers

Buildings should have seismic features

Participate in disaster prevention and mitigation drills or safety education and training

PROTECT AGAINST INDOOR EARTHQUAKE DANGERS

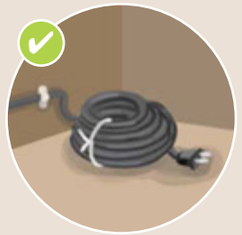
— Fasten or secure all furniture (such as bookcase, wardrobe and cupboard) that can topple over

— Remove or secure heavy hanging objects on walls and ceilings, such as baskets containing produce and grains

— Remove heavy or large objects from high places; otherwise they can fall

— Secure inflammables and explosives, hot-water containers, and heating appliances (electric stoves, coal stoves, etc.)

— Check and keep gas stoves / cookers, gas pipelines, and liquefied gas tanks safe



— Properly handle unburied wires (open wires)

LEARN HOW TO MAKE YOURSELF AND YOUR FAMILY SAFER

One of the most important ways to keep yourself and your family safe is to live in an earthquake-resistant house. When building your own house, please take proper earthquake resistant measures, such as to build the walls first with ring beams and structural columns, make rooms smaller, consult local earthquake authorities when necessary, and hire masons who have participated in the "Skill Training Project for Rural Construction Workers on Earthquake-Resistant Buildings" programme.

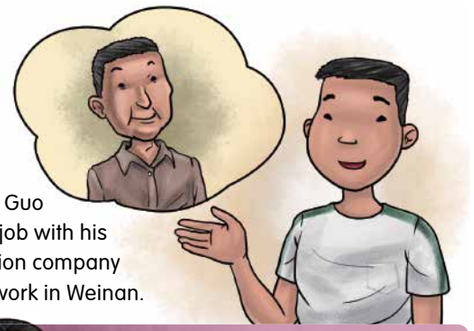
Primary and middle schools, working units/organizations, and communities should carry out disaster reduction drills, safety or disaster education and training, or other preparedness activities every year. Actively participate in these efforts, so you are ready to respond to a possible future disaster.

CHAPTER 13

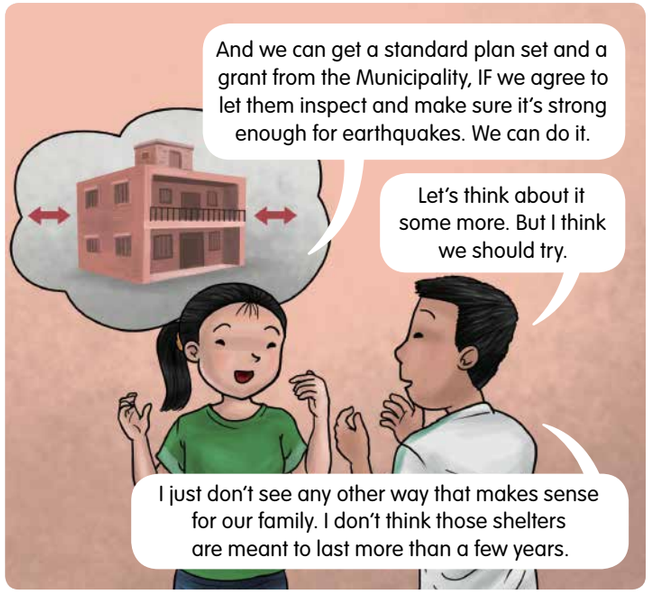
Building an Earthquake-Resistant House

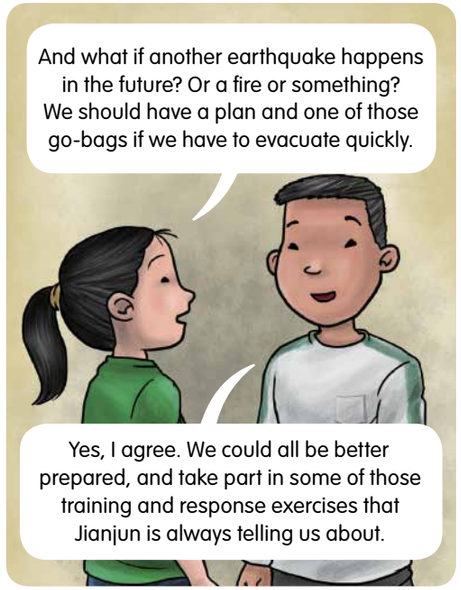
TIME One month later

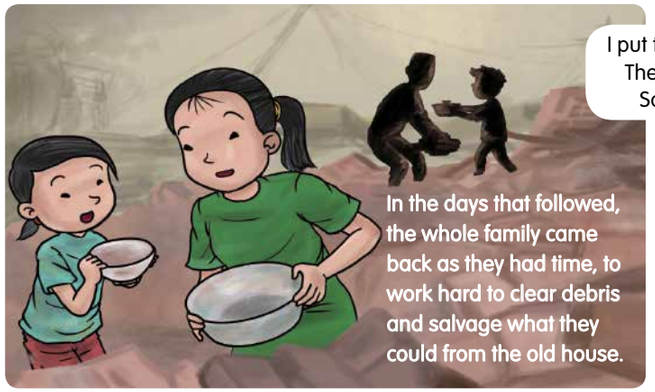
PLACE The village shelter, atop a tableland of Linwei District of Weinan

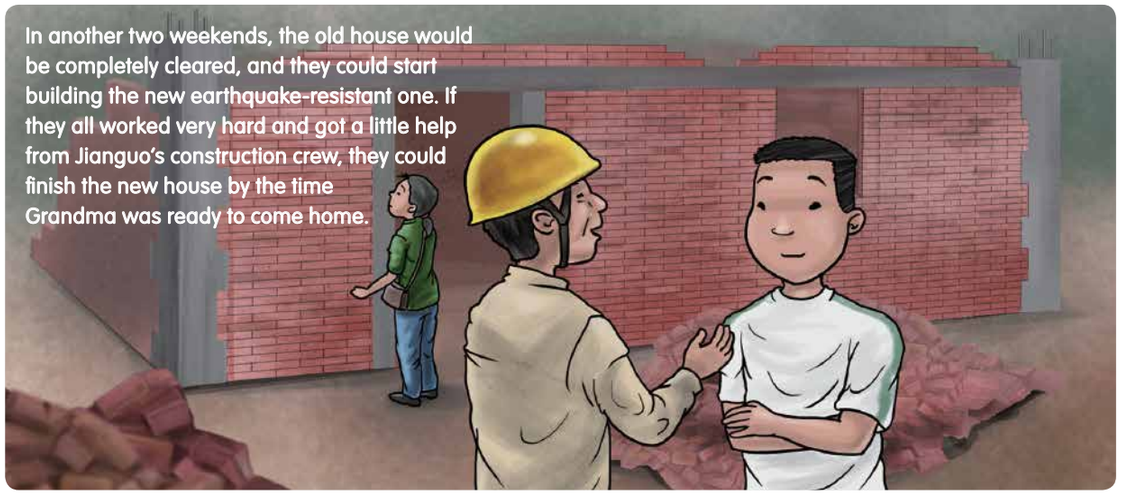


Recently, foreman Guo had gotten him a job with his cousin's construction company doing rebuilding work in Weinan.







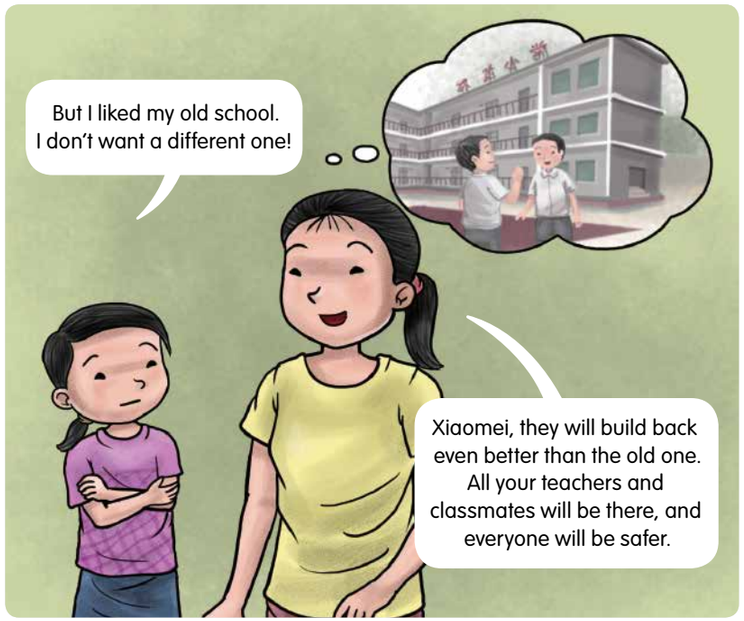


CHAPTER 14

Longing to Go Back to School

TIME Three months later

PLACE At great-uncle's house, atop the Weinan tableland

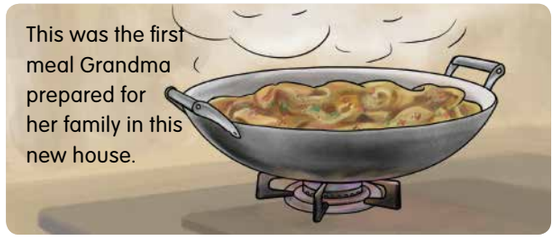


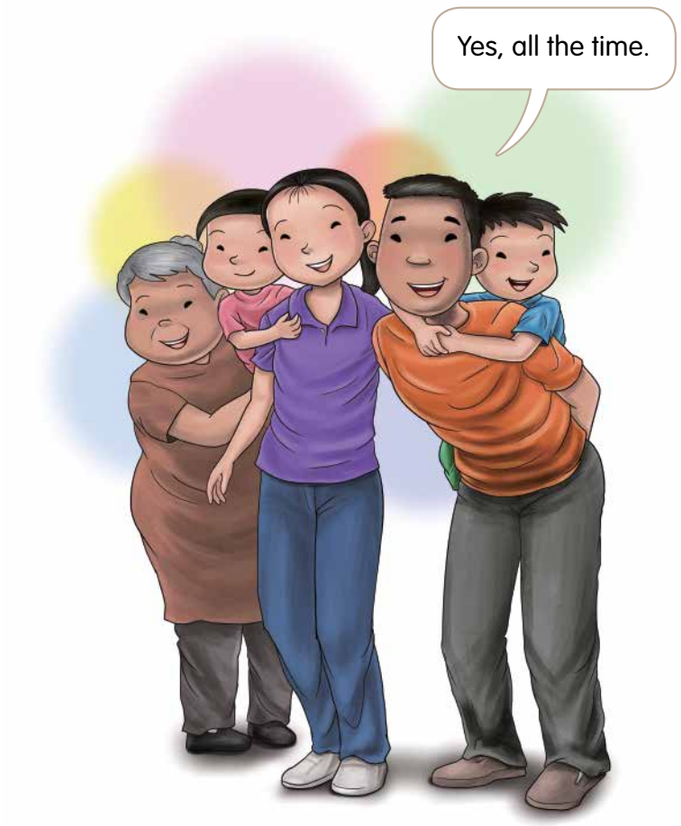
CHAPTER 15

A Meal Together

TIME / Four months later

PLACE / Xingfu village, atop the Weinan tableland in Linwei District




Yes, all the time.

MAIN IMPLEMENTATION ORGANIZATIONS

China
- Institute of Geology, China Earthquake Administration (CEA)
- China Earthquake Disaster Prevention Center (CEDPC)
- The Hong Kong Polytechnic University, China

United Kingdom and United States
- Overseas Development Institute (ODI), UK
- Department of Earth Sciences, University of Oxford, UK
- Department of Architecture, University of Cambridge, UK
- GeoHazards International (GHI), USA

FUNDERS

- National Natural Science Foundation of China (NSFC), China
- Natural Environment Research Council (NERC), UK
- Economic and Social Research Council (ESRC), UK
- Newton Fund, UK

A story about how a strong earthquake affects a family with "left-behind" children

Version for the General Public

This hypothetical scenario will help you understand the specific consequences of a damaging earthquake and how to protect yourself. It is also intended to inspire you to act now to make yourself and your family safer in any possible future earthquake.

TIPS FOR DISASTER RISK REDUCTION

- Earthquake knowledge
- Response to earthquakes
- Search
- Rescue
- Disaster preparedness
- Earthquake disaster risk reduction tips
- and more …