Sound of Science
理聲
Newsletter of Science Promotion Team
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Quake leaves destruction, fear

People in Japan face a catastrophe that has gone from terrible to tragic. The disaster began as an earthquake that launched a powerful ocean wave, called a tsunami, that caused destruction all along the coast. Those natural disasters damaged a cluster of nuclear reactors in Japan, leading to one of the worst nuclear disasters in recent years.

"My homeland has been struck by a tragedy of cataclysmic proportions. This has been one of the greatest natural disasters of modern times, the full extent of which is still becoming clear," said Yukiya Amano, the director general of the International Atomic Energy Agency, in a press conference on March 14. "The events of the last few days are truly unprecedented."

On the afternoon of Friday, March 11, an earthquake struck the floor of the Pacific Ocean 80 miles east of northern Japan. The U.S. Geological Survey reported the earthquake had a magnitude of 9.0, making it one of the most powerful in recent history. The magnitude of an earthquake is determined by measuring how strongly the Earth shook. People reported feeling the ground move all across the island country, both during the first quake itself and during hundreds of others that followed. Those later, smaller earthquakes are called aftershocks.

During the earthquake, the sea floor moved. That motion made the water go up and down and caused a tsunami, or a powerful ocean wave, that moved outward from the center of the earthquake site like the ripples that you see when a pebble drops in a pond. These ripples, though, were giant and spread out over the ocean. Waves are how energy moves across the surface of the ocean, and when these waves struck Japan's coast, they brought destruction. Within minutes, coastal towns flooded as unknown numbers of people were swept away with cars, boats and even buildings. Countries around the Pacific Ocean received tsunami warnings.

About 180 miles north of Tokyo, Japan's capital city, two nuclear reactors were seriously damaged by the earthquake and tsunami. Although the reactors were equipped with safety devices intended to shut them down in case of an earthquake, the backup power supplies were also damaged by the quake and the tsunami. As a result, they failed.

The inside machinery of the reactors needs to be kept cool; if it's not cool enough, a reactor could melt and possibly even destroy the protective metal vessel that encases the nuclear fuel. During a meltdown, radiation could be released into the air, threatening the health and safety of people nearby.

These nuclear reactors, part of a facility called Fukushima Daiichi, generate electricity for millions of people through a process called fission. During fission, a larger atom breaks into two or more smaller atoms. At most of the reactors at Fukushima Daiichi, atoms of an element called uranium-235 are the ones that break apart. Uranium-235 is natural on Earth, but it is unstable — which means it's always ready to break apart. (The number 235 identifies how many protons and neutrons make up the nucleus, or heart, of a single atom.)

When an atom of uranium-235 fissions, it forms smaller atoms but also releases particles called neutrons. These particles can hit other atoms of uranium-235 and cause them to break apart — and then those newly split atoms release neutrons, which keep the reaction going and going. This is what occurs inside a nuclear reactor.

This reaction happens inside narrow rods that hold fuel pellets, which are immersed in water. As they undergo fission, the atoms inside the fuel rods produce heat. That heat will be transferred to water outside the reactor. As that water turns into steam, it is used to turns turbines that produce electricity.

Nuclear fission generates a lot of heat, so the nuclear reactors in which fission occurs need water to keep everything cool. At Fukushima Daiichi, which includes six reactors, water became the problem. According to the Nuclear and Industrial Safety Agency in Japan, the reactors lost power after the earthquake. That wasn't a problem because backup generators started pumping water to remove heat building up inside the reactors. But when the tsunami struck, it took out those backup generators — leaving the reactors dangerously hot. Then, another backup system, running on batteries, started. But it couldn't keep up.

Explosions have seriously damaged other buildings associated with four of the reactors. A big and yet-unanswered question is whether it was the explosions or the excess heat in the reactor's core that damaged the vessel that contains the fuel.

The core has become damaged. It appears to largely be holding the radioactive gases that have been developing. At times, however, reactor-safety teams have released small amounts of those radioactive gases to reduce the pressure in the vessel that holds the fuel.

Radiation levels around the reactors have become dangerous.

One reason is that old fuel rods from the six reactors at Fukushima Daiichi are stored near the reactors in pools of water. In many cases, those fuel rods are still quite hot. Circulating water is needed to cool these old fuel rods. But when the tsunami knocked out backup cooling to these pools, some lost much if not all of their water for a time. Under these conditions, radiation levels can increase enough to imperil the lives of workers. And on several occasions in the first week following the accident, many workers were sent home for their safety.

Some steam released from the reactors has also left the facility. Radiation from that steam has been detected in the countryside. Levels of radiation were not high, but because they could become high on short notice, people living within 20 kilometers of the reactor facility were told to evacuate. Those living between 20 and 30 kilometers of the plants were advised to stay indoors.

Even tinier amounts of radiation — levels almost too low to measure — have crossed the Pacific Ocean and been recorded in Washington State and California. As of March 21, these levels were too small to pose a risk to people living in the United States.

It will take months for Japanese officials to bring the reactors under control and for the country to dig out from the triple disaster that hit. Stay tuned.

輻射的本質

了解輻射和如何測量輻射對於確定其對人體健康的影響十分重要。量度對細胞組織產生破壞的輻射劑量有助於了解輻射對健康的影響。輻射包括粒子射線（如阿爾發和貝塔射線），電磁射線（如伽瑪射線和 X 射線）和中子。阿爾發（ α ）射線來源於氡、鈾和鈈等放射性核的自發衰變。阿爾發射線只能通過 1 毫米厚的水層。因爲一張紙就能阻擋阿爾發射線，只有當輻射阿爾發射線的粒子通過食物被攝入體內時，阿爾發射線才對健康造成影響。貝塔（ β ）射線包含快速的電子（其質量只有中子或質子的兩千分之一），由碳-14、鍶-90、磷-32 及氫-3（氚）等核的自發衰變產生。與阿爾發射線類似，貝塔射線也只通過內輻射（即攝入人體後的輻射）來損害健康。伽瑪（ γ ）射線是於可見光相似的電磁波，但是比紫外線具有更短的波長和更高的能量。伽瑪射線在鈷-60 等放射性物質的衰變過程中產生。由於可以穿透人體，伽瑪射線常用於癌症的放射治療。 X 射線與伽瑪射線類似，但是具有不同的波長。中子則由前訴的鈈或鈾的核裂變產生。

輻射的量度與劑量

輻射可以用多種方式來測量。最早提出測試輻射方法的瑪麗和皮埃爾„居里夫婦。他們的測量單位是用放射性物質樣品中每秒發生衰變的原子數目來描述輻射的強度，並以1克鐳中每秒37×109 個原子發生衰變爲基礎。這一測量單位後來被稱爲“居里” 。常用的表示輻射強度的單位還有雷姆（即人體倫琴當量）和西弗特（又譯希沃特） 。美國以雷姆爲單位，而國際單位制採用西弗特（或希沃特） 。這兩個單位可按如下關係轉換：1雷姆 = 0.01西弗特 = 10 毫西弗特。

輻射通常用蓋革計數器來測量。蓋革計數器包括一根充滿特殊氣體的管子和被這根管子分隔的兩個電極。輻射通過這根管子與管中的氣體作用時引起電脈衝。電脈衝被計量表記錄或以咔噠聲表示。在給定時間內的脈衝數就用來量度輻射的強度。我們環境中的輻射就可以用蓋革計數器來測量。

表一. 輻射事件與劑量舉例

一次輻射	輻射劑量
牙科X-光照相	0.005毫西弗特
居住於三哩島核事故發生地16公里範圍內	平均0.08毫西弗特，最大1毫西弗特
腦CT掃描	0.8 – 5毫西弗特
胸CT掃描	6 – 18毫西弗特
國際放射保護委員會向防止核事故升級的自願者推薦的輻射上限	500毫西弗特
國際放射保護委員會向搶救生命的自願者推薦的輻射上限 1000 毫西弗特	1000毫西弗特
一年累計輻射	
„ 居住在核電站附近： 0.0001 – 0.01毫西弗特/年; 居住在燃煤火力發電站附近： 0.0003毫西弗特/年 „ 在海平面上的宇宙輻射（來自天空） ：0.24毫西弗特/年; 來自陸地的輻射： 0.28毫西弗特/年 „ 個人受到的平均環境輻射：2毫西弗特/年; 1.5毫西弗特/年(對澳大利亞人); 3.0毫西弗特/年（對美國人） „ 紐約到東京的航班乘務員：9毫西弗特/年 „ 吸煙（每日一包半） ：13-60毫西弗特/年 „ 核工業工人的平均限制: 20毫西弗特/年 „ 伊朗、印度及歐洲的局部地區的環境輻射: 50毫西弗特/年 „ 針對福島核危機中工人的升高後的限制： 250毫西弗特/年	

輻射對健康的影響

輻射中的不同粒子並不總是對細胞造成直接的破壞。因爲中子不帶電荷，它們很少直接破壞細胞，卻在與人體內的氫原子核作用後引起離子化，從而比伽瑪射線造成對人體更嚴重的損傷。離子化也可以引起氧化反應，從而造成染色體異常或細胞死亡。**表二. 輻射的穿透深度與危害**

輻射種類	可以被下列材料阻擋	在生物組織中的作用範圍	相對生物效力
阿爾發（ α ）	一張紙	0.005厘米	10 - 20
貝塔（ β ）	一毫米厚的鋁	3厘米	1
伽瑪（ γ ）	幾英吋厚的水泥牆	約20厘米	1

Science Quiz (科 CEPT)

Questions are posted on the notice board of Science Promotion Team near the Staff Common Room. For more details, please refer to the notice board.

Science Promotion Team 2010-2011:

Chairperson: Yang Chun Pong 楊雋邦 5D

Committee Member: Chung Lai Him 鍾禮謙 5D, Hung Ka Kiu 洪嘉僑 5D, Lee Lok Tin 李樂天 5D, Lo Wai Ki 盧偉祺 5D, Mak Chun Wing 麥駿穎 5D, Lo Lai Fong 盧麗芳 5E & Yip Tsz Fung 葉子楓 5E

Website: http://210.3.43.253/~lck/science/spt1011/spt1011.htm

Lunch Time Video Shows: 12:20 p.m. @ Chem. Lab. (Room 512)

Date	Name of Program	Language / Subtitle	Area
5/5 (Thu)	Wonders Of The Solar System - Empire of the Sun (Part I) 太陽系的奇迹 - 太陽帝國	English / Chinese & English	Astronomy 天文學
9/5 (Mon)	Wonders Of The Solar System - Empire of the Sun (Part II) 太陽系的奇迹 - 太陽帝國	English / Chinese & English	Astronomy 天文學
12/5 (Thu)	Nature's Great Events - The Great Great Migration (Part I) 自然界大事件 -大遷徙	Cantonese / Chinese	Biology 生物學
19/5 (Thu)	Nature's Great Events - The Great Great Migration (Part II) 自然界大事件 -大遷徙	Cantonese / Chinese	Biology 生物學
23/5 (Mon)	How Earth Made Us – Human Planet (Part I) 天造地設 – 人類地球	English / Chinese & English	Earth Science 地球科學
26/5 (Thu)	How Earth Made Us – Human Planet (Part II) 天造地設 – 人類地球	English / Chinese & English	Earth Science 地球科學

第八屆國際初中科學奧林匹克香港區項選拔賽

是由教育局資優教育組、香港數理教育學會及行政長官 卓越教學獎教師協會聯合主辦的比賽。是項選拔賽，旨在識別有科學天賦的初中學生，參加進階科學 知識培訓課程。期望學生可以透過培訓課程，促進學生的協作、批判性思維、創意與溝通技巧方面的發展。六名經過訓練的學生，將代表香港參加 2012 年 12 月初舉行的第九屆國際初中科學奧林匹克。 國際初中科學奧林匹克通常爲期十天。 國際初中科學奧林匹克是一項讓 16 歲以下的中學生在自然科學方面比賽的年度活動。參賽第八屆國際初中科學奧林匹克的學生必須於 1997 年 1 月 1 日或以後出生。**比賽結果：本校張炫梓同學(2A) 獲得一等獎、傅嘉輝同學(2A)、陳哲同學(2B)及周浩翔同學(2B)獲得三等獎。**

賀

香港物理奧林匹克

教育局、香港物理奧林匹克委員會和香港物理學會於 2003 年首辦「香港物理奧林匹克」，目的是爲在物理學方面具備優越潛能的學生，提供增益學習的機會。比賽中表現優異的學生將有機會參加爲期約一年的物理培訓活動。在培訓中表現最爲傑出的 5 名學生可獲選代表香港參加「國際物理奧林匹克」。**比賽結果：本校劉梓謙同學(4E)及賴銘傑同學(5E)獲得二等獎。**