Royal Geographical Society with IBG

The Geography of Science fact sheet

	Key ideas	Key facts
Lesson 1: Introducing geographical flashpoints.	**Geographical flashpoints are examples of different major world events that can impact on many people/places.** **By looking at three different case studies, both geographers and scientists have an interest in and an involvement in these flashpoints.**	The idea of geographical flashpoints is routed in geopolitical theory. It has been used here as a way of bringing together three very different case studies which share some common elements. The three topical case studies of swine flu, the Sichuan earthquake and climate change all have had or do have the potential to impact on many people and/or places. **The swine flu** pandemic is an outbreak of what is formally, a re-assortment of four virus strains. The World Health Organization has called it a "public health emergency of international concern." The virus is essentially a respiratory condition. It is often more virulent in autumn and winter, but it can be contracted at any time. The World Health Organisation (WHO) is always particularly concerned when there is a significantly new strain of flu as its pattern of spread cannot be fully anticipated. With the worst flu virus killing around 40 million people in 1918-1919, it is clearly a matter of considerable concern. Swine flu has the potential to impact thousands, if not millions of people around the world. This however, depends on the success of the disease's spread and possible mutation. When a virus mutates it is difficult to predict, but scientists have to study the mutation in order to design a vaccine that might combat it. The vaccine is derived from the virus itself and is designed to invoke an immune response that will create a set of antibodies which will be able to overpower the condition within an individual. Scientists use the knowledge from one pandemic to help solve problems relating to another. Due to the interconnectedness of the globe because of the ease of air travel, diseases are able to spread internationally much more readily. This has been the case with swine flu. However, at the time of writing, those affected by swine flu internationally remains relatively low. **Key words** *Disease* –a disordered or incorrectly functioning organ, part, structure, or system of the body resulting from the effect of genetic or developmental errors, infection, poisons, nutritional deficiency or imbalance, toxicity, or unfavorable environmental factors; illness; sickness; ailment. *Contagion – The communication by direct or indirect contact.* *Diffusion – To spread or scatter widely.*

		Virus – ultramicroscopic infectious agent that replicates only in cells of living hosts. *Pandemic- (of a disease) prevalent throughout a whole country, continent, or the whole world.* *Epidemic- Affecting many people at the same time and spreading from person to person in a locality.* **Sichuan earthquake** – The 3 minute earthquake occurred on 12th May, 2008 in the Sichuan Province of Chengdu, in Central China. The earthquake measured 8.0 on the Richter Scale. The earthquake killed an estimated 70,000 people. This huge impact on people was thought to be primarily due to the time of day as children were at school and office workers were still at work and due to sub-standard building in the area. For more details see lesson 3 below. **Key words** *Richter Scale* – the amount of seismic energy released by an earthquake. The magnitude is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. E.g. a recording of 7 has a ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 30 for every unit increase in the Richter Scale. *Tremor***-** a minor earthquake, a minor seismic shaking or vibrating. Tremors often precede larger earthquakes. *Fault line* – a fracture in rock in which the rock on one side of the fracture has moved with respect to the rock on the other side. Large faults in the earth's crust are the locations for most earthquakes. *Epicentre* – the point on the earth's surface that is directly above the focus, the point where the earthquake originates. On the surface above the focus, is where there is usually the most damage during an earthquake. Seismograph – is an instrument which makes a record of the seismic waves caused by an earthquake. **Climate change** has the potential to impact on millions of people globally. Indeed it is already beginning to impact on some areas of the world such as sub-Saharan Africa. It is generally agreed that humans have helped to increase climate change due to the emission of greenhouse gases. The

		impacts on people in the future may be due to sea level rise, lack of food, water and energy resources and desertification. For more details on the impacts of climate change, see lessons 4 and 5 below. **Key words** *Greenhouse gases – gases including carbon dioxide, methane, ozone and fluorocarbons whose absorption of solar radiation is responsible for the greenhouse effect.* *Extinctions – (a species) coming to an end/dying out.* *Ecosystems – a system formed by the interaction of a community of organisms with their environment.*
Lesson 2: Swine flu: an over-reaction?	**What is the distribution of the swine flu pandemic?** **Some media portrayals of the pandemic may have been exaggerated and biased.**	The distribution of the swine flu pandemic (at the time of writing) was concentrated in North America (notably the USA), Central America (notably Mexico), South America, UK, Australia and New Zealand. There were also notable (but fewer) numbers affected in Asia (including Thailand, China and the Philippines). The BBC website is a good source of information for the latest facts and figures on the pandemic: News reports in the UK, especially during the initial stages of the swine flu outbreak predicted huge death tolls in the UK due to swine flu (see this Metro article 'Swine flu could kill up to 120 million' This arguably resulted in unnecessary panic about the disease and its potential threat on the population. As a result doctors' surgeries and NHS Direct services were inundated and could barely cope with the influx of cases and queries. In addition, work places saw surges in sick days as people feared they may have swine flu. The media is certainly an important source of information. Newspapers, television reports, internet sources as well as on-line chat rooms and forums have all had a part to play in spreading information about swine flu. In reality, in the UK, as of the 30th July 2009, 11,159 people had been affected by swine flu and 30 people had died. When these figures, or indeed the world affected figures (340,000 laboratory confirmed cases worldwide as of 27th September 2009) are compared with other major world diseases such as seasonal flu, malaria, TB or even deaths due to road traffic accidents, the numbers remain (at the time of writing) to be relatively low. This is not to say that swine flu is not a significant health emergency. Swine flu continues to impact many people worldwide and has the potential to kill many people. However a realistic perspective is required. By examining bias, students are able to formulate their own opinions and gain a balanced perspective. There are cross-curricular links here with the KS3 English curriculum.
Lesson 3: Sichuan Earthquake: lessons learnt?	**How earthquakes happen.**	The earth's crust is made up of huge tectonic plates which move slowly on the molten mantle beneath the earth's crust. The plates meet on conservative (plates slide past each other), destructive (plates collide into each other) and constructive (plates move away from each other) plate boundaries.

	Earthquakes affect a huge number of people.	Earthquakes occur along these plate boundaries or fault lines. The Sichuan earthquake occurred along a destructive plate margin, where the Indo-Australian Plate and the Eurasian Plate collide. The earthquake occurred along a mid-fracture (known as the Yingxiu-Beichuan fracture). The earthquake in Sichuan was a magnitude 7.9 on the Richter Scale, occurred at a depth of 19 meters and its epicentre was in Wenchuan, north-east in the Sichuan Province. Dams – it is estimated that approximately 400 dams have been affected by the Sichuan earthquake (2008). The safety of these dams is a concern as many may not have been designed to withstand earthquakes. Some Chinese and US scientists believe that the quake could have been triggered by the huge Zipingpu dam. The dam is 50 stories tall and holds back several hundred million tons of water in the Zipingpu reservoir. It is situated just 500 meters from the Beichuan fault, only 5.5 kilometres from the epicentre of the earthquake. The Beichuan fault would have been under natural stress but this would have been multiplied by 25 times due to the weight of the water in the reservoir. The Sichuan earthquake killed approximately 70,000 people, although other estimates put the total far higher. More than 10,000 children were killed when their schools collapsed or were buried beneath landslides. At least 4,727 children were orphaned as a result of the quake. The quake also left 5 million people homeless and 375,000 people injured. The impacts of this quake will be felt for generations to come especially as families tend to have only one child due to China's strict 'One Child Policy'. Other impacts of the quake include: the collapse of buildings, particularly in the Beichuan County, the collapse of two chemical plants which led to the leakage of 80 tons of liquid ammonia which buried many people. Schools, homes and buildings were destroyed.
	Changes can be made to reduce the impact of earthquakes on people and places.	The Sichuan earthquake killed many people due to unsafe building construction, particularly that of schools which were referred to by local people as 'tofu dregs'. There is a great deal in modern construction techniques which can be done to reduce the impact of earthquakes on people and reduce the death toll. Within the USA, there are strict building codes for buildings within earthquake zones. These can help ensure minimum standards of building. In addition, instruments are installed in public buildings to measure the response of buildings to earthquakes. The response of buildings to earthquakes can be measured and then alterations to their construction can be made. It is also considered that metal buildings are far better at withstanding an earthquake than concrete ones because metal ones are more ductile (they can bend and flex without breaking). It is also important to consider the distribution of weight. A building which is top heavy is much more likely to fall than a building which is light weight on the top. Therefore, an earthquake building should be constructed of steel rebar but should be framed with lighter materials in the upper floors and have a heavily reinforced lower section. However, just because it is made of metal, does not mean it will not fall down during an earthquake. In the USA, residential buildings are designed so that the roof falls directly in the middle of the room

		but stays up near the wall. People are then advised to take shelter in the doorways and away from the middle of the room. Scientists have considered the side to side movements during an earthquake in the design of earthquake proof buildings. However, they are now considering the up and down (vertical) movements also. To ensure that buildings are able to move in all directions, scientists suggest isolating the building from the ground in order to reduce the vibrations from an earthquake. Instead of having the foundation rest directly on soil or rock, use a material that will provide a cushioning effect and reduce the energy transfer from the ground to the building. Also, using liquid dampers. These are like putting a water tank at the top of the building. These are particularly useful where there are high winds.
Lesson 4: Climate change: global impacts	**What is climate change?** **Climate change may impact on world population distribution in a variety of ways**	Climate change refers to changes in the earth's temperature over the last 100 years. Since 1900, the average temperature on the planet has increased by 0.75 degrees Celsius and the UK's sea level has risen by about 10cm. There is strong evidence that the increases in temperatures experienced over the last 100 years cannot be explained by natural causes alone. Humans are changing the climate by their actions, particularly by emitting greenhouse gases. There are various theories as to the potential global impacts that climate change may have on people in the future. These impacts may include sea level rise causing flooding, more extreme weather events such as hurricanes, impacts on food, water and energy supplies and changes in animal species and the distribution of diseases. It is uncertain how populations will respond to changes in climate due to global warming. However, theories suggest that there may be large population movements from low lying areas where climate change has affected sea level to areas where it has not. For example, areas in Southern India and Bangladesh which happen to have some of the highest populations and population densities may see flooding if the temperatures were to increase by 4 degrees Celsius. This may cause mass migrations of people to areas which have not been affected by flooding. This lesson is theoretical as these actions are based on a series of assumptions: • Climate change will continue to cause temperatures to increase. • Humans will continue emitting greenhouse gases at the same rate or an increased rate as they are doing currently. • People/governments have not stepped in long before an impending crisis to work together to reduce the impacts of climate change on areas that will be seriously affected by climate change. If climate change was to impact people in this way, there are likely to be areas of gain and areas of loss in population. Not all areas of the world are likely to be affected equally. • Areas which may gain in population due to stable or improved conditions for human habitation: Canada, Patagonia in Argentina, Antarctica and New Zealand.

	Population changes and climate change impacts are unlikely to be evenly distributed. **Geographers and scientists can work together to reduce the impact of climate change.**	• Areas which may loose population due to being submerged by water or due to desert conditions making human habitation very difficult or impossible: South-west USA, parts of southern Europe, large parts of Australia, Amazon Rainforest, Polynesia, Peru, Southern India, most of African continent. It is important to stress that this is theory and we do not know for sure how populations may change/move. Most theorists believe there is likely to be some kind of mass migration of people. See 'climate change to force mass migration' article in The Guardian. However, some commentators have suggested that the idea of mass population movement is unlikely. See 'climate migration fears misplaced' at the BBC News Website. Whatever the outcome, climate change is impacting on people now and geographers and scientists have a role to play in reducing the impact that climate change is having on people all around the globe. Food, water and space shortages are just three problems that may cause problems in the future due to climate change. Geographers and scientists can work together to reduce these impacts. **Food shortages**: Geographers can use GIS technology to map changes in farming and food production due to climate change. Scientists help farmers by developing new varieties of crops that are more fuel and water efficient as well as being able to survive in difficult environments. **Water shortages**: Geographers can graph and map water use to detect where the hot spots of water use exist and who is using the most. Scientists can develop new more efficient technologies to reduce water use e.g. more efficient washing machines or small scale technologies such as water harvesting. Scientists can develop novel ways of transporting water from areas of surplus to areas of deficit. **Space shortages**: Geographers can study and record the distribution of populations and what people need in terms of living space. Scientists can develop novel ways of using space in building construction and ways of making unsuitable areas inhabitable.
Lesson 5: Flood in London: A mission impossible?	**Climate change poses potential threats for London**	Major floods in London have always been a part of London life. A tidal surge in 1953 caused the Thames and the East coast to flood, killing 300 people. This resulted in a review of flood defences – most notably the building of the Thames Barrier. Climate change poses potential threats to London, where 1,250,000 people live/work on the floodplain worth an estimated £80 billion. The likelihood of tidal flooding is increasing because sea level is rising. It is estimated that climate change could increase fluvial and coastal risk by a factor of 8 – 12 times. Research for the London Climate Change Partnership estimated that by the 2080s, winters will be 30% wetter, heavy winter rainfall could occur twice as frequently and the number of storms crossing the UK each winter could increase from 5 to 8. Relative sea level in the Thames Estuary with extreme sea levels experienced more frequently. See page 7 of 'London Under Threat'.

	London is not very well prepared for major floods **Major floods could impact many people and places** **Relevant agencies need more plans in place for major flooding in London.**	London is at risk of flood by: • Tidal – overtopping of existing defences due to a severe storm surge in the North Sea. Also if the tidal defences fail to operate. • Fluvial – due to freshwater flows in a tributary that exceeds the capacity of the channel especially if undefended or breached. • Surface water – usually as the result of intense rainfall in a summer thunderstorm that exceeds the capacity of the drainage system. • The following may also increase flood risk: sewage, water main burst, groundwater, contained water e.g. reservoirs. The Thames Barrier provides good protection for London at present but should there be a major flooding event, the barrier could be breached. In addition, the Thames Barrier was constructed with a life expectancy spanning until 2030. The Environment Agency along with several London water companies have been drafting up plans to reduce the likelihood of major floods in London between 2015 and 2030 which is estimated to cost in the region of £4 billion. Among the ideas to protect Londoners include: raising homes on stilts, Bangladesh-style escape roads, using large areas of Kent and Essex farmland to flood waters during a tidal surge. Some property owners along the River Thames have already put up temporary flood barriers for when waters are particularly high. However, in the future this may not be enough. Building more defences is not always the answer and is not always a sustainable solution. The Environment Agency is also conducting a feasibility study for a new barrier to be sited down river. A barrier there would halt the surge before it reached central London. The designers of the Thames Barrier claim that only a tidal surge severe enough to occur only once in 1,000 years could currently flood London. However, this seemingly small risk is increased due to climate change. In January 2003, the barrier had to be lowered a record 19 times to prevent flooding during heavy rains. The impact on Londoners would be huge: there are 38 underground stations that could fill with water, 8 power stations, 16 hospitals, 400 schools and 500,000 properties. This would also cause a huge amount of economic disruption to businesses in the city. In addition, there could be sludgy water ponding in low lying areas, damaged homes would not be inhabitable and services and emergency services would not be able to function properly. The London Assembly Environment Committee (2005) said that "fragmented responsibility for maintaining flood defences and lack of clarity over planning are putting London at risk." Clear and strong planning policy is crucially needed to protect London. See BBC News article 'Warning over flood defense' for more information. To see the roles of various organisations in the incidence of a major flood see: Page 18-27 of the government report London Flood Response Strategic Plan

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Lesson 6: Reducing the impact of flashpoints	**There are impacts associated with geographical flashpoints** **Solutions can be found to reduce the impact of geographical flashpoints** **Geographers and scientists have roles/interests in these flashpoint solutions**	The three flashpoint examples of swine flu, Sichuan earthquake and climate change all impact on people and places on different scales (locally, nationally, globally) and in different ways (primarily on people or the environment or on people and places). See the lessons above for details on the impacts associated with the three flashpoints. Geographers and scientists can work together to find appropriate solutions for the problems associated with these three flashpoints: **Swine flu** – Geographers can map the changes and dispersal of the disease to help scientists understand its spread. Scientists can work on understanding how the disease is mutating and develop appropriate drugs and vaccines. Both geographers and scientists can have roles in helping to educate people about the spread of disease by advising government and educational bodies as well as the media on changes in the spread of the disease, so that these groups can advise patients and/or the general public on the best course of action, to protect people and restrict the further spread of the pandemic. **Earthquake (Sichuan)** – Both geographers and scientists have an interest in tectonic movement of the earth's plates and can study the occurrence of earthquakes in a particular area in order to advise other professionals on good building practice and laws and codes of building to protect people. Geographers can develop maps to show risky areas for building, so that structures such as dams and power stations can be built in suitable locations away from major fault lines, while scientists can work on new structures that can withstand earthquakes. **Climate change** – Both geographers and scientists have an interest in climate change. Geographers can monitor climate and climate change, recording results in graphs and maps that can be used by other professionals to help plan for the future. Some research has shown that the risk of malaria may occur in previously unaffected areas as temperatures increase with altitude. Both geographers and scientists have a role in helping to educate people about ways to prevent malaria and scientists may formulate new drugs to protect people. As temperatures increase, theories suggest that some areas of the earth that were previously unusable for agriculture, now become useful. However, this needs adaptation. Geographers would be interested in studying the viability of the soil and landscape for agriculture, while scientists may be able to develop new crops which are adapted to new altitudes, soil conditions and temperature. As climate changes, pressures may be exerted on animal survival. Both geographers and scientists have a keen interest in species survival. Both could pressurise governments to ensure that the wellbeing of animals were preserved by the creation of possible refuges or corridors where animals could be protected.