

## STAGE 2 Scientific Studies

### Assessment Type 1 – Inquiry Folio (SHE Task)

#### Summative Task: Human Impacts on the Environment

Date .....

Name .....

SACE No. ....

This assessment task provides opportunities for students to demonstrate the ability to:

- demonstrate a broad knowledge and understanding of a range of science inquiry skills and scientific concepts (KA1)
- explore and understand the interaction between science and society (KA3).
- communicate knowledge and understanding of scientific concepts, using appropriate terms, conventions, and representations (KA4).

#### Description of assessment

Students explore the impact of humans on a Wilderness area of their choosing. They identify how human activity has led to environmental damage and investigate the role of science in monitoring and remediation of the issue. They explore and understand the connection between science and society through this topic.

#### 1500 Word Limit

#### Task Outline:

You will be required to investigate a **contemporary** (modern/recent) example of how science interacts with society, with the main focus being on the impact of humans on a Wilderness area of their choosing. You will be required to identify how human activity has led to environmental damage and investigate the role of science in monitoring and remediation of the issue.

You will need to analyse and synthesise information from different sources to explain the scientific concepts relevant to the focus of their investigation, show its connections to science as a human endeavour, and develop and justify their own conclusions. Some introductory sources will be provided to you.

To complete this task successfully, you will need to explore the connection between science and society through this topic, by focusing on one or more of the Science as a Human Endeavour key concepts listed below:

#### Communication and Collaboration

- Science is a global enterprise that relies on clear communication, international conventions, and review and verification of results.
- Collaboration between scientists, governments, and other agencies is often required in scientific research and enterprise.

#### Development

- Development of complex scientific models and/or theories often requires a wide range of evidence from many sources and across disciplines.
- New technologies improve the efficiency of scientific procedures, practices, and data collection and analysis. This can reveal new evidence that may modify or replace models, theories, and processes.

#### Influence

- Advances in scientific understanding in one field can influence and be influenced by other areas of science, technology, engineering, and mathematics.
- The acceptance and use of scientific knowledge can be influenced by social, economic, cultural, and ethical considerations.

#### Application and Limitation

- Scientific knowledge, understanding, and inquiry can enable scientists to develop solutions, make discoveries, design action for sustainability, evaluate economic, social, cultural, and environmental impacts, offer valid explanations, and make reliable predictions.

- The use of scientific knowledge may have beneficial or unexpected consequences; this requires monitoring, assessment, and evaluation of risk, and provides opportunities for innovation.
- Science informs public debate and is in turn influenced by public debate; at times, there may be complex, unanticipated variables or insufficient data that may limit possible conclusions.

### Research, Plan and Report

1. You will need to do some research and choose a wilderness area. This is an individual task and each student will have a different area, with no double ups being permitted. Make sure to have some extra options if your first preference is taken.

2. Based on your research you will be required to **produce a 1500 word report** that includes the following:

- an **introduction** to identify the focus of the investigation and the key concept(s) of science as a human endeavour that it links to
- **relevant scientific concepts or background**. A non-exhaustive list of examples of information that could be included in this discussion is:
  - a description of the wilderness area including the size, species diversity, climate
  - the importance of maintaining the wilderness area in terms of species conservation, support of connected ecosystems, societal needs and ethical considerations.
  - a description of human activities that have impacted, or are impacting the ecosystem including a discussion of why the activities are causing change and how the ecosystem is being affected.
- an **explanation** of how the focus of the investigation illustrates the **interaction between science and society**. This must include:
  - a clear statement of the SHE key concept that is being discussed
  - general statements about the types of evidence that your chosen SHE concept can be demonstrated by
  - specific examples connected with your investigation that illustrate the general statements you have made. This must include details about how science is being used to monitor your chosen wilderness area and/or lead to action for sustainability
- a conclusion
- citations and referencing.

## Performance Standards for Stage 2 Scientific Studies

Investigation, Analysis, and Evaluation	Knowledge and Application
<p><b>A</b> Critically deconstructs a problem and designs a <b>logical, coherent, and detailed</b> scientific investigation using a scientific method and/or engineering design process.</p> <p>Obtains, records, and represents data, using <b>appropriate</b> procedures, conventions and formats <b>accurately and highly effectively</b>.</p> <p><b>Systematically</b> analyses and interprets data and evidence to formulate <b>logical</b> conclusions with <b>detailed</b> justification.</p> <p><b>Critically and logically</b> evaluates procedures and their effect on data.</p> <p><b>Critically and perceptively</b> evaluates the effectiveness of collaboration and its impact on results/outcomes.</p>	<p>Demonstrates <b>deep and broad</b> knowledge and understanding of a <b>range</b> of science inquiry skills and scientific concepts.</p> <p>Applies science inquiry skills and scientific concepts <b>highly effectively</b> in new and familiar contexts.</p> <p><b>Critically</b> explores and understands in <b>depth</b> the interaction between science and society.</p> <p>Communicates knowledge and understanding of science concepts coherently, with <b>highly effective</b> use of <b>appropriate</b> terms, conventions, and representations.</p>
<p><b>B</b> Logically deconstructs a problem and designs a <b>well-considered and clear</b> scientific investigation using a scientific method and/or engineering design process.</p> <p>Obtains, records, and represents data, using <b>appropriate</b> procedures, conventions and formats <b>mostly accurately and effectively</b>.</p> <p><b>Logically</b> analyses and interprets data and evidence to formulate <b>suitable</b> conclusions with <b>reasonable</b> justification.</p> <p><b>Logically</b> evaluates procedures and their effect on data.</p> <p><b>Critically</b> evaluates the effectiveness of collaboration and its impact on results/outcomes.</p>	<p>Demonstrates <b>some depth and breadth</b> of knowledge and understanding of a <b>range</b> of science inquiry skills and scientific concepts.</p> <p>Applies science inquiry skills and scientific concepts <b>mostly effectively</b> in new and familiar contexts.</p> <p><b>Logically</b> explores and understands in <b>some depth</b> the interaction between science and society.</p> <p>Communicates knowledge and understanding of science concepts with <b>mostly coherent and effective</b> use of appropriate terms, conventions, and representations.</p>
<p><b>C</b> Deconstructs a problem and designs a <b>considered and generally clear</b> scientific investigation using a scientific method and/or engineering design process.</p> <p>Obtains, records, and represents data, using <b>generally appropriate</b> procedures, conventions and formats with <b>some errors but generally accurately and effectively</b>.</p> <p>Undertakes <b>some</b> analysis and interpretation of data and evidence to formulate <b>generally appropriate</b> conclusions with <b>some</b> justification.</p> <p>Evaluates procedures and <b>some</b> of their effect on data.</p> <p>Evaluates the effectiveness of collaboration and its impact on results/outcomes.</p>	<p>Demonstrates knowledge and understanding of a <b>general range</b> of science inquiry skills and scientific concepts.</p> <p>Applies science inquiry skills and scientific concepts <b>generally effectively</b> in new or familiar contexts.</p> <p><b>Explores and understands aspects of the interaction between science and society.</b></p> <p><b>Communicates knowledge and understanding of science concepts with generally effective use of appropriate terms, conventions, and representations.</b></p>
<p><b>D</b> Prepares a <b>basic</b> deconstruction of a problem and an <b>outline</b> of a scientific investigation using a scientific method and/or engineering design process.</p> <p>Obtains, records, and represents data, using procedures, conventions, and formats <b>inconsistently</b>, with <b>occasional accuracy and effectiveness</b>.</p> <p><b>Describes</b> data and undertakes some <b>basic</b> interpretation to formulate a <b>basic</b> conclusion.</p> <p><b>Attempts</b> to evaluate procedures or <b>suggest</b> an effect on data.</p> <p><b>Attempts</b> to evaluate the effectiveness of collaboration and its impact on results/outcomes.</p>	<p>Demonstrates <b>some basic</b> knowledge and <b>partial understanding</b> of science inquiry skills and scientific concepts.</p> <p>Applies <b>some</b> science inquiry skills and scientific concepts in familiar contexts.</p> <p><b>Partially</b> explores and <b>recognises</b> aspects of the interaction between science and society.</p> <p>Communicates basic scientific information, using <b>some</b> appropriate terms, conventions, <b>and/or</b> representations.</p>
<p><b>E</b> Attempts a <b>simple</b> deconstruction of a problem and a procedure for a scientific investigation using a scientific method and/or engineering design process.</p> <p><b>Attempts</b> to use <b>some</b> procedures and record and represent some data, with <b>limited</b> accuracy or effectiveness.</p> <p><b>Attempts</b> to <b>describe</b> results <b>and/or</b> interpret data to formulate a basic conclusion.</p> <p><b>Acknowledges</b> that procedures affect data.</p> <p><b>Acknowledges</b> the effectiveness of collaboration and its impact on results/outcomes.</p>	<p>Demonstrates <b>limited</b> recognition and <b>awareness</b> of science inquiry skills <b>and/or</b> scientific concepts.</p> <p><b>Attempts</b> to apply science inquiry skills <b>and/or</b> scientific concepts in <b>familiar</b> contexts.</p> <p><b>Attempts</b> to explore and identify <b>an aspect</b> of the interaction between science and society.</p> <p><b>Attempts</b> to communicate <b>information</b> about science.</p>

**Please note:**

- This is one task from a folio comprising five tasks and may not be representative of the overall Folio grade.
- Any notes in coloured text boxes are added to provide information and support for teachers.
- Parts of the student report have been highlighted with the colour that corresponds to the colour of the relevant text box.

## Introduction:

The Ganges River is known to be one of the most polluted rivers in the world, this is due to humans heavily impacting the river with the population rapidly increasing in India. The two key concepts of science as a human endeavour that fit in the category of the current situation of the issues with Ganges River are Application and Limitation and Communication and Collaboration. The focus on this issue is the pollution found in The Ganges River and what dangers they may contain to society and any possible solutions.

## Relevant scientific concepts or background

The Ganges River, also recognised in Hindi as Ganga, is a river located in northern India that flows towards the border with Bangladesh. It is the longest river located in India and flows for approximately 2,525km starting from the Himalayan Mountains to the Bay of Bengal. Whilst being the largest river in India, it has the

second greatest water discharge in the world, and its basin is known to be the most heavily populated in the world with over 400 million people living in the basin.

The Ganges River is sacred and extremely important to the people of India as the polluted river is used for daily tasks and needs such as bathing, cleaning and fishing.

The Ganges River used

to be home to over 10,000 dolphins until the conditions of the water were so contaminated it initially caused the rate of dolphins to decrease to between 1,200-

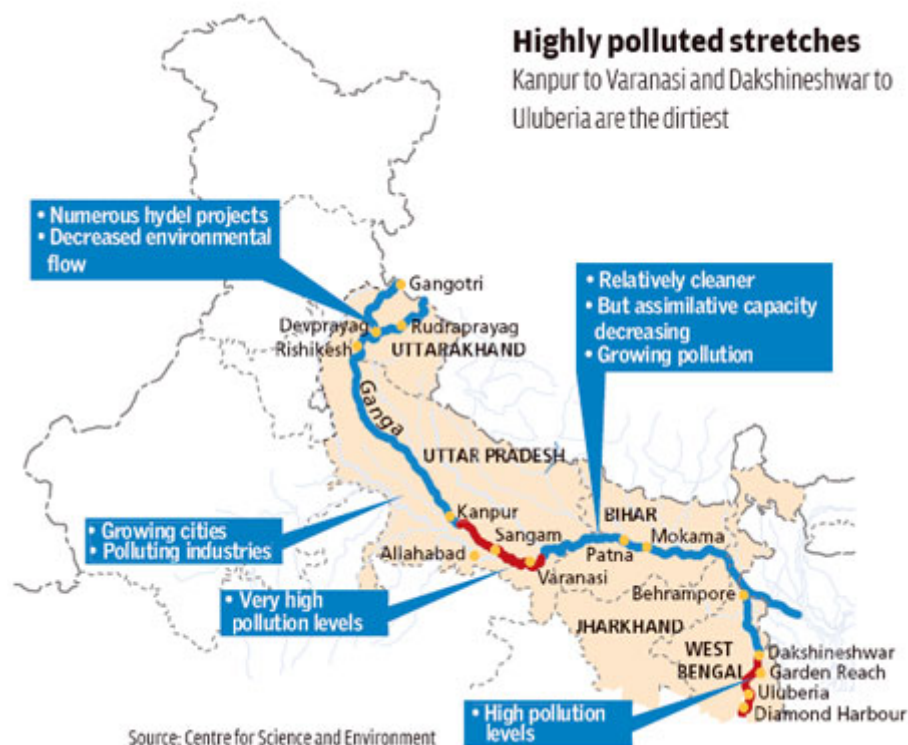


Figure 1 Map of The Ganges River, displaying pollution levels in each area.

KA1, Evidence shown is largely research about the Ganges with some limited scientific inquiry.

1,800. The Ganges River is also home to Mahseer fish, gharials, turtles, otters and other species. The survival of the Ganges River dolphins has become difficult, this is due to unintentional killing with the use of fishermen leaving nets inside the river resulting in the dolphin becoming entangled and



Figure 2 An image of a Ganges River Dolphin

then harvested for dolphin oil. Dolphin oil is used to attract other species of fish and medicinal purposes. The population of the dolphins in the Ganges River are perishing due to water development projects (e.g. water extraction and the construction of barrages, high dams and embankments). This changes the landscape of the river and affects the habitat that the dolphins live and ensuing the decrease in the population of dolphins. Industrial waste, pesticides, municipal sewage discharge, noise from vessel traffic; and overexploitation of prey are all major factors to the decrease in population of the Ganges River dolphins. With the decrease dolphin population, an ensuing result of other species would overpopulate the river resulting in an imbalance of food web in the river. The water quality affects the fishes making them hazardous to consume due to the unsanitary level of the river. This will inevitably affect the local civilians as well, this is due to because they fish in the Ganges River for food and they will consume the contaminated fish which would cause sickness to the locals.

KA1, Identification of issues with human interaction and the impact of these changes on the environment.

The climate surrounding the Ganges River usually has a warm environment with the average temperature on August being 16.7 degrees Celsius whilst the highest it's ever been was 22.2 degrees Celsius. The average temperature on January is found to be the lowest temperature averaging 3.2 degrees Celsius.

### GANGES WEATHER BY MONTH // WEATHER AVERAGES

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	3.2	4.5	6.2	8.7	11.8	14.6	16.8	16.7	14	10	6	3.7
Min. Temperature (°C)	0.3	0.9	2.1	4.2	7	9.7	11.4	11.2	9	5.8	2.7	0.8
Max. Temperature (°C)	6.2	8.2	10.3	13.2	16.6	19.5	22.2	22.2	19.1	14.2	9.4	6.6
Avg. Temperature (°F)	37.8	40.1	43.2	47.7	53.2	58.3	62.2	62.1	57.2	50.0	42.8	38.7
Min. Temperature (°F)	32.5	33.6	35.8	39.6	44.6	49.5	52.5	52.2	48.2	42.4	36.9	33.4
Max. Temperature (°F)	43.2	46.8	50.5	55.8	61.9	67.1	72.0	72.0	66.4	57.6	48.9	43.9
Precipitation / Rainfall (mm)	167	120	96	62	43	33	23	28	47	104	177	178

Figure 3 Ganges River weather averages by month in degrees Celsius °C



In order for the organisms living in and around the Ganges River to survive, it is extremely vital to maintain the river as a variety of species rely on either the usage of the habitat or for food it contains. The Ganges River is used by millions of people as a need of water, transport and food. Kumbh Mela is a Hindu pilgrimage that is hosted at the Ganges River and is known for its largest human gathering in the world with 120 million people participating to bathe themselves for over 49 days. The Hindus believe that the Ganges River is personified as the goddess Ganga written in ancient texts and art. The ashes of loved ones are spread across the river, this exposes it to further contamination. Whilst the river is known for being extraordinary dirty, there are some areas that are less polluted such as the great Himalayas. The reason great the Himalayas is less polluted is due to there being less humans to impact the river with littering. Whilst the more populated area such as the Bengal is much more polluted due to more exposure of humans. The population of Bengal is 96 million which is rapidly growing increasing in tourism which at the end effects the river in a negative way. The Himalayas is homed to over 50 million people which may be the reason it is less polluted as there is less tourism and attraction.

KA4, Generally effective communication of knowledge and understanding.



Figure 4 Ganges River in Himalayas Mountains



Figure 5 Ganges River in Bengal

The Ganges River provides a water source to more than 400 million civilians of the country, but the river is also a dumping place for industrial waste, sewage, and human and animal faeces, urine and even bodies which poses a great threat to the health of the people who live next to the river. Even though the civilians can see the pollution and the defilement, the traditional belief of the holiness of the

river neutralise any warnings of health risks. Due to the increase in pollution over the years this makes living conditions for any type of living organisms difficult and will essentially die out.

In 2015, there was an expected 1.3 billion individuals at risk for cholera in 69 countries identified as cholera-endemic, with India being the top country with the highest increasing number of people reported of being at risk. Cholera is an infection of the small intestine by some strains of the bacterium. In the 19<sup>th</sup> century, the disease had spread

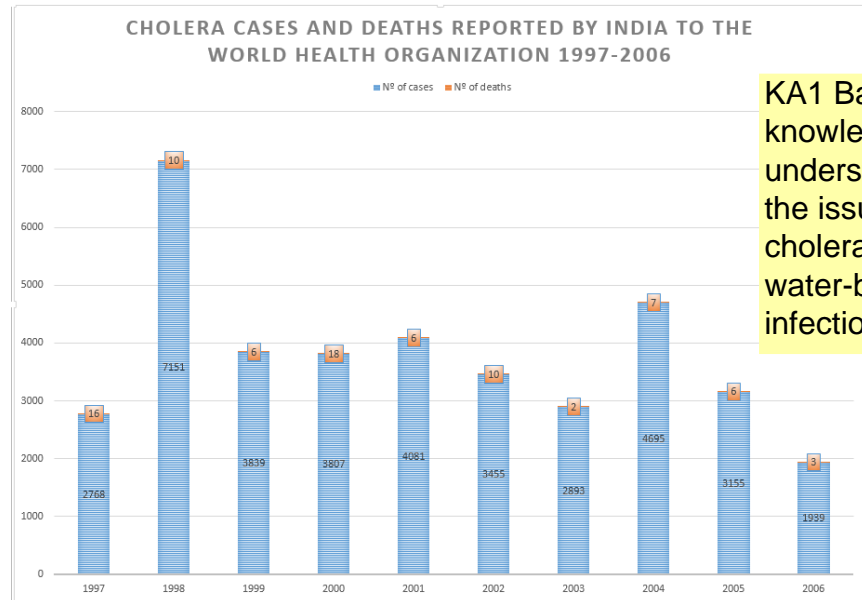


Figure 6 Graph of cholera cases and deaths report in India between year 1997-2006

KA1 Basic knowledge and understanding of the issues of cholera as a water-borne infectious disease

across all over the world from its own reservoir in the Ganges delta. Experts predict that in India the disease will become more frequent due to the major effects of climate change. If there was an effective medical treatment for the people in India and were treated quickly and properly, the mortality rate would be less than 1%. Certain genetic strains of Cholera, like the one in 2004 of an outbreak in India, can potentially cause death within two hours of becoming infected.

## Key Concepts

This problem in the Ganges is compromising the human health and the natural ecosystem and has come to the attention of different groups and organisations. Evidence of the SHE concepts **Communication and Collaboration** is present in this focus. Attempts and claims of cleaning the river have been announced by many others, including the current Prime Minister of India, Narendra Modi. Narendra Modi pledged when he became PM in 2014 to lead efforts to reduce pollution by building more treatment plants and Tanneries away from the river to

prevent more waste from entering the river, to date the \$3 Billion clean-up plan has never come to pass. A new administration was announced, the regulation stated that no waste is allowed to be dumped within a half a kilometre of the river's edge, any littering of any sort will result in a fine in the sum of 50,000 rupees. There is to be no construction work within 100 metres of the river and that 456 of the tannery units are to be moved away from the river in the time span of 6 weeks, and if they are not relocated, then the tanneries will be shut down.

### **Application and Limitation**

The government of India has begun an empowered authorisation called the *National Mission for Clean Ganga*. This a team of authorised police officers who are responsible for disbursing the 20000 rupee or \$413.51 AUD towards multiple projects that involve assembling a sewage treatment plants, replacing woodfired crematoriums with electric ones, construction a biodiversity parks that will enable native species from the Ganges river such as the river dolphin and rare turtles to increase in their numbers and planting trees in attempts to improve the water table in the surrounding regions and prevent any soil erosion. The authorities have focused on having large trash skimmers travel through the Ganges River and collect the garbage and improve on the crematoria. However, a complication has occurred with the plan being commenced, installing sewage treatment plants have been delayed. Barley 20000 rupees of the 20,000 has been spent so far. The government claims that the reason that there has been a delay is due to him wanting to put in place an extremely transparent tendering process. An established system has also been created called *The Hybrid-annuity model*. This system is used in commissioning highways, for selecting organisations that will manages STPS (Super Thermal Power Stations). Being controlled by this, firms would be given almost half the money upfront to set up a plant and the rest with a profit margin at regular intervals. 63 sewage management systems are being implemented in Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal. Application and Limitation also requires monitoring the situation and make assessments on how The Ganges River will progress in the future. Contamination in waters causes millions of cases of these specific types of diseases every year.

KA3,  
addressed  
SHE concepts  
identifying a  
broad range of  
stakeholders.



Results of an epidemiological study analyses the relationship between the quality of water supply and sanitation versus human health vary widely and there are multiple methodological problems taken for the studies. One of the many main reasons for these difficulties is the fecal-oral route which includes multiple routes for the infection to travel through. However, with adequate amount of evidence to support the conclusion that the key to control these diseases is to improve sanitation, which is adequate to support the stated conclusion that the solution to control these disease is for improved sanitation. By installing and maintain a proper sewage system or improved treatment facilities this will better the condition of the diseases

### **Conclusion**

In conclusion, although certain sections of the Ganges River are quite clean (near the Himalayan Mountains), most parts of the river are still extremely contaminated. The continuous dumping of waste such as industrial, human and animal waste have rendered most parts of the Ganges River severely polluted and into a safety hazard for the civilians and animals living next to it. The key concepts aforementioned have been attempted continuously over the years in order to cleanse the Ganges River from its current volatile state.

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WWF. (2019). *The Ganges*. [online] Available at: <https://www.wwf.org.uk/where-we-work/places/ganges> [Accessed 8 Aug. 2019].

This task primarily reads as a research task on the Ganges with some interaction of SHE concepts within the task. Students could have provided more specific examples such as the effect of pollution in the Ganges. For example, if the student had addressed Tanneries they could have researched the chemicals involved in tanning and then how this would impact the ecosystem. This might have provided the opportunity to mention government funding and the agencies that were in place to support this change. The issues with a large range of topics discussed in a SHE task is that it dilutes the capacity to drill down into SHE and how this would impact the overall picture.