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Science and Technology in ancient India

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Abstract:

Ancient India has demonstrated a high level of scientific and technological knowledge. This chapter examines the embedded principles of STEM [Science, Technology, Engineering and Mathematics] within India's heritage through archeological evidence, classical texts, cultural practices and architectural exemplars. The high urban planning and sanitation systems of the Indus Valley civilisations, the engineering of water-tight public structures, illustrate empirical knowledge applied to large-scale civic life.

The chapter shares dietary habits and hygiene customs, part of our daily life routine, culturally transmitted through generations, rooted in physiology, microbiology and chronobiology. These practices highlight an implicit understanding of human health and environmental interaction predating modern systems.

A study of a few temple complexes like the Brihadeeswara temple, Konark Sun temple, and Kailasa temple highlights sophisticated applications of structural engineering, astronomy, geometry and geological science. The Brihadeeshwara temple highlights how a massive stone weighing around 80 tons was lifted to the top of the tower without modern equipment. The Konark temple highlights how the wheels act as sundials. The Kailasa temple establishes high level of precision where main structure was carved from one continuous mass of rock.

The chapter advocates that we engage critically with these ancient knowledge systems to strengthen contemporary STEM education. By integrating historical scientific traditions with modern pedagogy, we promote scientific literacy, contextual learning and inquiry-based thinking. Only when we will acknowledge India's rich STEM heritage, will we augment historical understanding and foster rigour and cultural confidence among learners.

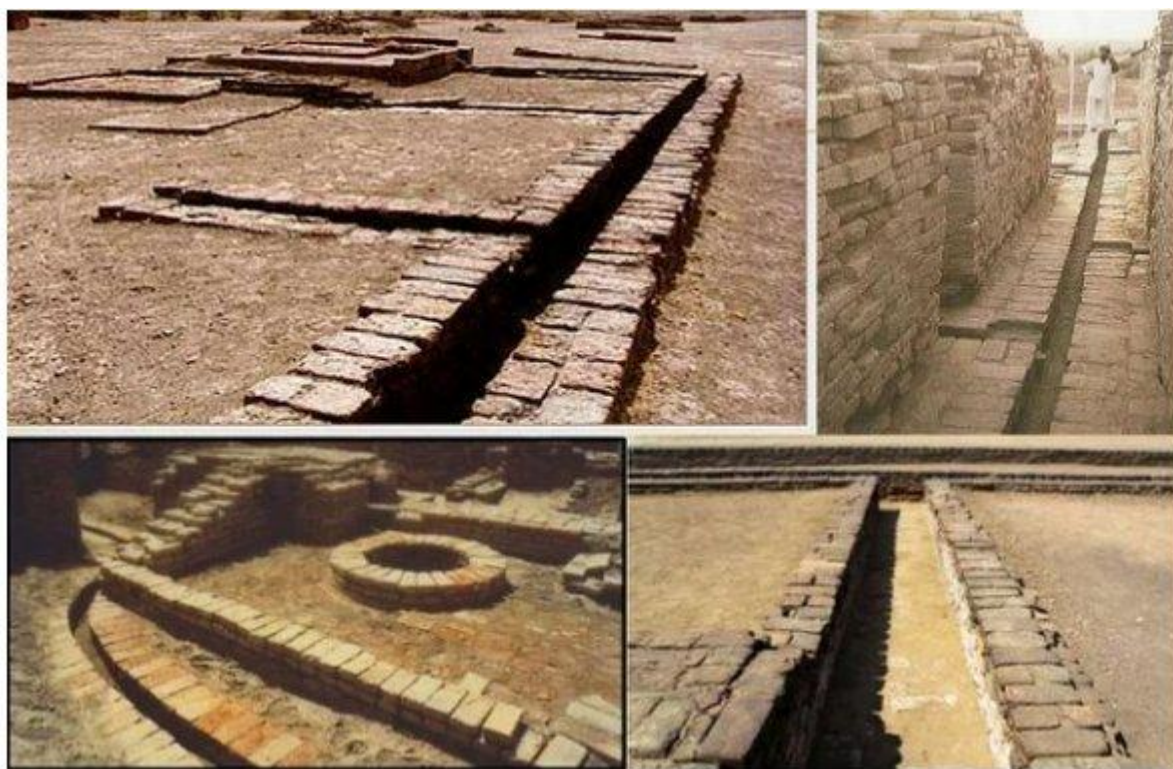
Keywords: #STEM #AncientIndia #Templearchitecture #customs #sanitation

Science and Technology in Ancient India

India is among the world's oldest civilisations, with cultural and societal roots dating back to 5000 B.C.E. Early Indian society developed profound scholarly philosophies, which we now find preserved in foundational texts such as the Vedas, Ramayana, and Mahabharata. The amassed knowledge transmitted through centuries reflects a strong grounding in the scientific, philosophical,

and technological foundations. Archaeological evidence from the Indus Valley civilisation further supports this legacy, revealing state-of-the-art drainage systems, highly organized urban planning, standardised brick production, and well-developed construction techniques. The Great Bath of Mohenjo-Daro is the earliest public water tank in the world. It measures 11.88 X 7.01 metres and has a depth of 2.43 m. The floor tank was made water-tight using gypsum plaster and bitumen. The roads also intersect at right angles, showcasing the grid formation.

Sanitation of the Indus Valley Civilisation



Source: <https://www.thearchaeologist.org/blog/sanitation-of-the-indus-valley-civilisation>

In fact, have you ever critically reviewed our daily routines and practices? Well, most of our traditions and customs are deeply rooted in science. Ever wondered how natural it feels to eat with your hands? It turns out there's a scientific reason behind it. The nerve endings on our fingertips can sense temperature, texture of the food, and level of moisture. Thus, when we touch our food, these nerves send signals to our brain, commencing digestion even before we take our first bite. Isn't that mind -blowing? This reaction is called the cephalic phase of digestion, during which the body begins releasing digestive enzymes in anticipation of food. Our body has around trillions of supportive microorganisms that support digestion. When we eat with clean hands, we might introduce tiny amounts of harmless bacteria that can actually help maintain a healthy, balanced gut.

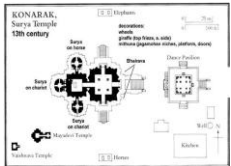
Another tradition among the Jain community is to eat before sunset, often termed as 'Choviyaar'. Why? Well, it is linked to improved digestion, as our metabolism is high between 10 am and 3 pm. This practice supports us in weight management, blood sugar control, and alignment with our circadian rhythms. Today, everyone is speaking of intermittent fasting, but our ancestors spoke of it aeons ago.

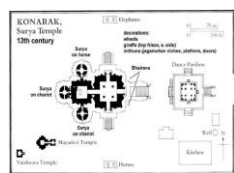
There are numerous practices within our daily life that endorse scientific thinking among our ancestors. One such practice is removing our shoes once we reach home. Why do we do that? Well, our shoes have travelled places where they could have gathered many germs or bacteria, creating an unhealthy environment where diseases could flourish. Likewise, we always wash our hands and feet when we arrive home after moving outdoors.

Across the Indian subcontinent, our temples are ubiquitous features of the built landscape, embodying sophisticated engineering and technology expertise developed over the past centuries. A systematic examination of these structures allows for a deeper understanding of the STEM domains involved. The specific architectural features and structural features they display, and the extent to which these attributes are supported by archaeological, historical and material evidence.

STEM DOMAINS IN EACH TEMPLE

Temple Overview	STEM Domain	Technology Used	Documented evidence of STEM in temple design
Brihadeeswarar Temple (11th c.) Thanjavur (Tanjore), Tamil Nadu, by Raja Raja Chola I	Structural Engineering	Engineers had to lift a massive stone weighing around 80 tons to the top of the tower without modern equipment. It is believed that they used a specially constructed 6.44 km (4-mile) ramp to gradually move the stone into position.	The temple is constructed using granite blocks fitted using gravity, friction, and precise stone dressing, suggesting a long ramp was used.
 Source: https://www.thedecorjournalindia.com/brihadeshwara-temple-know-as-thanjai-periya-kovil	Structural Geometry	The temple has a 216-ft tower with nearly vertical inclination. One of the tallest temple towers in India.	Temple Vimana is 216 ft tall, nearly vertical with no curvature.

Konark Sun Temple (13th century) Orissa	Astronomy	Solar alignment with sunrise	Temple oriented east; first rays illuminated sanctum
	Science - Astronomy & Physics	The wheels act as sundials.	The 24 wheels are not merely decorative but act as accurate timekeepers. Shadows cast by the sun onto the spokes and beads (smaller beads between spokes) indicate time to the minute.
	Geometry & Symmetry Structural Ratios	The temple's 24 wheels correspond to the 24 hours of the day, while the 7 horses pulling the chariot are said to represent the 7 days of the week. The design incorporates advanced geometric principles to ensure stability and alignment with solar paths.	The wheels represent complex geometric precision, with 8 spokes each, functioning as 24-hour markers.
Kailasa Temple (8th c.)	Geological Engineering	The temple is monolithic, carved into a volcanic, hard basalt cliff, requiring skilled use of iron tools and a deep empirical understanding of geology.	The main structure was carved from one continuous mass of rock. The temple is carved from Deccan basalt, a hard volcanic rock formed by ancient lava flows.
	Construction Engineering	The symmetry and precision indicate high levels of mathematical and architectural knowledge. The top-down method was used to execute the temple.	Prevented structural collapse, i.e., risk of roof failure, misalignment, and load imbalance; required full architectural planning before carving began. Temple shows bilateral symmetry,



Astronomy

Solar alignment with sunrise

Temple oriented east;
first rays illuminated
sanctum

Science -
Astronomy &
Physics

The wheels act as sundials.

The 24 wheels are not merely decorative but act as accurate timekeepers. Shadows cast by the sun onto the spokes and beads (smaller beads between spokes) indicate time to the minute.

Geometry & Symmetry

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Structural Ratios

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Kailasa Temple (8th c.)

Geological
Engineering

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The temple is carved from Deccan basalt, a hard volcanic rock formed by ancient lava flows.



Construction Engineering

The symmetry and precision indicate high levels of mathematical and architectural knowledge. The top-down method was used to execute the temple.

Prevented structural collapse, i.e., risk of roof failure, misalignment, and load imbalance; required full architectural planning before carving began. Temple shows bilateral symmetry,

			consistent proportional ratios, and accurate vertical and horizontal alignment.
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These exemplars represent only a small fraction of the scientific and technological knowledge embedded within India's civilizational heritage. From urban sanitation and material science to astronomy, medicine, mathematics and engineering, STEM principles were not confined to abstract theory but were actively applied to daily life, scientific organisation and monumental architecture. As this chapter demonstrates, engaging critically with these traditions not only deepens historical understanding but also strengthens scientific literacy, inquiry and contextual learning. Recognising and studying this legacy allows contemporary education systems to draw meaningful connections between past knowledge systems and present-day STEM learning, fostering pride, curiosity, and analytical thinking among learners.

Now, let me pose a few questions for you to research:

1. Sushruta, the author of Sushruta Samhita, is considered the father of surgery. He lived in ancient India around 600 BCE in Kashi, India. What were Sushruta's significant contributions towards the field of plastic and cataract surgery?
1. Aryabhata was a prominent Indian mathematician and astronomer, often called the Father of Indian Mathematics. His pieces of work include the Aryabhatiya (c. 499), the main surviving Scripture from Aryabhata's classical pieces of work, which is scripted in 118 verses describing Hindu Mathematics up to that time, and the now lost Aryasiddhanta. What were his significant contributions?
2. Acharya Kanada, also known as Kashyapa, a natural scientist and philosopher, formulated the theory of atoms 2500 years before John Dalton's discovery. What did his atomic theory state, and how did it measure vis-à-vis modern theory?
3. Bhaskara II, also known as Bhaskaracharya, was an Indian mathematician and astronomer. His mathematical works Lilavati" and Bijaganita are considered to be incomparable, and he laid down the foundations for calculus, algebra and trigonometry. What was his contribution to Mathematics in those areas?
4. Varahamihira was an Indian philosopher, astronomer, and mathematician, author of the *Pancha-siddhantika* ("Five Treatises"). What were his scientific and mathematical contributions?

The list is endless, and like a sea, the deeper one dives, the more jewels one discovers. It is time to take pride in our rich heritage, deeply rooted in STEM, that has long supported scientific literacy, fostered meaningful inquiry, and enabled the application of scientific principles in everyday life.

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