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CHAPTER NOTES

Exploration Class 9 Notes | CBSE Science Chapter 1

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Your teacher for Exploration



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Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Explain Exploration simply

What can the board exam ask?

Most important formulas

Quiz me on this chapter

Ask Ira anything...



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Exploration Class 9 Notes | CBSE Science Chapter 1

Exploration: Entering the World of Secondary Science is Chapter 1 of CBSE Class 9 Science (Exploration, 2026-27). It is a short opening chapter that explains how science works at the secondary stage. It covers how scientists use models to simplify complex systems, why science needs precise words, symbols and standard units, how mathematics acts as a language for relationships, and what the words law, theory and principle mean. It then moves to prediction and testing, the limits of scientific ideas, rough estimation, and how the branches of science connect with each other.

This chapter has no formula-based numericals. It sets up the habits every later chapter depends on: understand the situation first, pick the quantities that matter, write units every time, and check whether an answer is reasonable. Likely question types are short definitions (model, law, theory, principle), reasoning questions on simple estimation problems such as the air

Quick Answer - Exploration in 30 s

Science at the secondary stage asks for a simplified picture of a real system that is as treating a moving car as a point. Scientists use **units** so results can be shared and compared. It explains why the pattern occurs, and a **Theories** make testable predictions, standard **estimation** checks whether an answer



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All Key Terms at a Glance

Term	Meaning in this chapter	Example from NCERT
Model	A simplified way of looking at a real system that focuses only on what is most important for a given question	A moving car shown as a single point; the Earth treated as a smooth layered sphere
Assumption	A detail deliberately ignored or simplified on purpose while building a model	Neglecting air resistance for a falling object
Symbol	A letter agreed on internationally to stand for a quantity	m (mass), v (velocity), F (force), I (electric current), c (speed of light)
Standard (SI) unit	An agreed international measurement method everywhere	
Law	Describes a regularity observed in nature, often expressed as a mathematical relationship	
Theory	Explains why patterns occur, based on evidence gathered	
Principle	A broad idea that guides the sense of a given situation	
Prediction	A reasoned expectation based on evidence, made before doing the experiment	
Estimate	An approximate value used to check whether a result is reasonable or impossible	
Interdisciplinary problem	A real problem that requires knowledge from several branches of science to be solved together	



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Key Concepts

1. From the Middle Stage to the Secondary Stage

In the middle stage (Classes 6 to 8), science asked you to be curious, observe closely, ask questions and find out how things work. The secondary stage keeps that curiosity and adds a new emphasis: **deep exploration**. The chapter puts it this way: science is about what we know, and also about **how we know it**.

“How we know” involves these steps:

- observations lead to **measurements**;
- patterns are expressed using **symbols and equations**;
- **models** are built to represent complex systems;
- ideas are **tested**, often revised, and sometimes discarded.

The textbook itself is called **Exploration**, and it sums up this approach:

Symbol	
Magnifying glass	Careful observation: otherwise be missed
Compass	Direction: choosing a path knowing the limits of

Together they say that exploration in science has a purpose.

2. Models: Simplifying a Complex World

The natural world is complex, and studying it with this with **models**. A model is a simplified version of what is most important for a given question.

NCERT gives one model from each branch of science.



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Branch	Real system	Model used
Physics	A moving car	A single point
Chemistry	Atoms and molecules	Spheres joined by bonds
Biology	A cell	A diagram highlighting key parts
Earth science	The Earth	A smooth sphere layered into distinct regions

Assumptions. Building a model means making assumptions and deliberately ignoring some details. Two examples from the chapter:

- When studying a falling object, **air resistance may be neglected** to understand the basic effect of gravity.
- When studying how the heart pumps blood, the heart can be understood as a working circuit.

NCERT stresses that these choices are deliberate when answering the question.

How to decide what to keep. Start from the simple. What would change the answer (see the cricket ball). If the complex, extra details are added for greater accuracy.

Meet a Scientist: Meghnad Saha. When people first left out the detail of every atom, reaction and star as a **hot gas**, ignored many complex processes, **pressure, and how atoms formed ions**. The process is deeply connected to their temperature.

3. The Language of Science: Precision

Science uses words in a careful, precise way. Words like **reaction** have specific meanings in science and must be clearly and unambiguously.

To describe observations and compare results, scientists use **language** of terms, symbols and units. Quantities and current are represented by symbols like **m**.



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Where symbols come from. Scientific symbols often come from history and from international agreements. The speed of light is written **c** because it comes from the Latin word **celeritas**, meaning speed. Today the speed of light is one of the physical constants, defined to be **exactly 299792458 m/s**.

Why standard units matter: the kilogram. When we buy rice or vegetables, we expect a kilogram to mean the same amount everywhere. Measurements are based on agreed international standards. Standard units allow scientific results to be compared, and they ensure fairness in daily life and trade.

Why standard units matter: the aircraft fuel incident. NCERT describes a passenger aircraft that ran out of fuel mid-flight because of a mix-up in units.

- The flight needed **22,300 kg** of fuel in total.
- The ground crew used the density of fuel in **pounds (lb) per litre** instead of **kilograms (kg) per litre**.
- The aircraft was about **15,000 litres short**.
- It glided to an emergency landing. The

Pounds and kilograms are very different: 1 kilogram is about 2.2 pounds. Using pounds overstates the mass. Using standard units avoids errors.

4. Mathematics as the Language of Science

To make relationships between quantities, we use mathematics a language that helps us think clearly.

An equation is a compact statement. An equation relates quantities that are related. For example, describing motion with an equation can tell us answer where an object will be at a later time. We can use it to describe:

- rates of chemical reactions (chemistry)
- patterns of population growth (biology)
- changes in energy within a system (physics)

Using mathematics well. Using mathematics well requires an order to follow:



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1. Understand the situation first.
2. Identify the relevant quantities.
3. Use mathematical relationships to reason carefully.

Done in this order, equations become helpful guides in every numerical you solve in Classes 9 and 10.

5. Laws, Theories and Principles

As observations are repeated, measurements refined and ideas tested through experiments, our understanding becomes organised. Three words then have specific meanings:

Term	What it does	NCERT example
Law	Usually describes a regular pattern observed in nature, often in the form of a mathematical relationship	Newton’s laws of motion
Theory	Goes a step further: explains why patterns occur, based on evidence gathered over time and across different situations	Atomic theory
Principle	A broad idea that helps us understand a given situation	Principle of conservation of mass

A theory is a tested explanation. In every science, a theory is an explanation based on evidence.

Open to improvement. Laws, theories and principles can change as new evidence becomes available and our understanding becomes more reliable.

6. Prediction, Testing and the Limitations of Science

One of the greatest strengths of science is its ability to make predictions. Models and theories let us anticipate what will happen in a situation, perform an experiment, and in many cases, predict the outcome.



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NCERT examples: using ideas about motion, how far a kicked football will travel; using chemical reactions, how much carbon dioxide will be produced or how soft a baked bread would be; using biology, how one's breathing would change while running.

NCERT calls these **reasoned expectations**, built on evidence and careful thinking.

The prediction cycle.

- When a prediction matches observation, confidence in the underlying science grows.
- When it does not match, scientists re-examine their **assumptions, models or measurements**. NCERT says this second case is even more important, because it drives further exploration and deeper understanding.

Why weather forecasts sometimes go wrong. Weather depends on many changing factors: temperature, pressure, humidity and wind. Forecasts use measurements and models, but very tiny differences in conditions can grow over time and lead to something completely different. So forecasts are usually reliable for a few hours into the future.

Every theory has limits. Even the most successful theory is explored or when measurements become more precise, the strength of science. Scientists reject an idea when the evidence and belief play no part. No scientific theory is ever proven.

Checking a viral claim. A claim often shared on social media during an eclipse because it becomes hard to see the sun is just a play of shadows. What physical change can cause this? Does food go bad if it is not eaten? Conclude that no physical, chemical or biological change is involved.

7. Estimation: Is the Answer Reasonable?

NCERT recommends a three-step habit for estimation.

1. Understand the situation being studied.
2. Identify the quantities that matter.
3. Make a **rough estimate** to check whether the answer is reasonable.

An approximate estimate is often enough to check if the answer is reasonable. Estimating builds intuition and helps you develop a sense of reasoning perhaps much more than accurate calculations.



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How to estimate well.

- Break the quantity into smaller pieces you can guess (breaths per minute, volume per breath, minutes per day).
- Multiply the pieces, keeping units on every factor so they cancel correctly.
- Check the result a second way. If two different routes give answers close to each other, the estimate is probably reasonable.
- Set sensible bounds. For a family’s monthly rice, 100 g is clearly too little and a few tonnes is far too much.

8. Connected Branches and Science as a Human Activity

After Class 10, science is divided into branches such as **physics, chemistry, biology and earth science**, and your Class 9 and 10 chapters already focus on some of these areas.

The natural world has no such boundaries. Our knowledge, and the branches depend on our understanding climate change, developing need ideas from several disciplines together.

Example: how a mask works. During the COVID-19 pandemic, we learned how a mask works needs:

Branch	
Physics	Particle motion
Chemistry	Properties of
Biology	Size and beha
Mathematics	Modelling airf

Science is a human activity. Alongside its by curiosity, creativity, collaboration and c many people across cultures and generati scientific thinking helps you understand th critically and make sense of the world.



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Key Terms Sheet

This chapter has no formulas or reactions. Use this sheet of symbols and relations instead.

Item	What to remember
Assumption	Detail ignored on purpose, e.g. air resistance for a falling object
Symbols	m = mass, v = velocity, F = force, I = electric current, c = speed of light
Speed of light	c = 299792458 m/s exactly (a defined physical constant); c from Latin celeritas
Minutes in a day	$60 \times 24 = 1440$ minutes
Estimation chain	quantity per day minutes per day
Unit check	(3 balloons / m) 8640 litres / day
Three-step habit	Understand the check
Page-number symbols	Magnifying glass



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Important Definitions

- **Model:** a simplified way of looking at a important for a given question.
- **Assumption (in a model):** a detail that i manageable, such as neglecting air res
- **Law:** a statement that usually describes using words or mathematical relationsh
- **Theory:** an explanation of why observe time and available at that time, and on careful testing and critical examination.

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- **Principle:** a broad idea that helps us make sense of a given situation.
- **Prediction (scientific):** a reasoned expectation, based on evidence and careful thinking, of what will happen under new or different conditions.
- **Estimate:** an approximate value, found with round numbers and simple reasoning, used to judge whether a result is reasonable or impossible.
- **Standard unit:** a unit based on agreed international standards, so that a measurement means the same everywhere; SI units are the standard units used in science.

Solved Examples (NCERT-Based)

Example 1: A cricket shot (NCERT Example 1.1)

Question: Think of a cricket ball being hit for a six. You want to make a simple model. What details would you include? What would you ignore?

Step 1, fix the question. We must ask: "What details are important for the ball's path in the ground first?"

Step 2, sort the details.

Detail
Mass of the ball
Speed and direction of the hit
Brand of the bat, colour of the ball, grass on the field
Air resistance, spin, stitching at the seam



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Example 2: Let us model (NCERT Activity 1.1)

Question: Suppose you ride a bicycle from your school to your home. You want to model the time it takes to go home from school. What details would you keep? What details could you ignore? Suggest why ignoring some details may actually be useful.

Model answer: Time depends on distance and speed, so keep what changes either of them.

- **Keep:** the length of the route, your usual riding speed, stops at traffic signals or crossings, steep slopes that slow you down, and heavy traffic at that time of day.
- **Ignore:** the colour and brand of the bicycle, what is in your school bag (unless it is very heavy), the shop names along the road, and the exact shape of each turn.
- **Why ignoring helps:** fewer details make the model quick to use and easy to check, and details can be added later if the prediction turns out wrong.

Example 3: How do we check predictions? (NCERT Example 4.2)

Question: Varsha told her friend Meghna, “It will be dark”. Think of some questions Meghna could ask to make the prediction testable.

Answer: Good scientific questions look for yes/no answers. Questions that start with “yes/no” are usually less useful. More useful questions are those that ask for measurable data.

- What was the condition of the sky when it started to look dark?
- What is the humidity today? Was it above or below 50%?
- What is today’s wind speed and direction?
- Is the temperature dropping like it did before it started to look dark?

These questions ask about measurable data. They can be tested to see if it started to look dark.”

Example 4: Air breathed in one day

Question: Estimate how many litres of air you breathe in one day. Assume that you take 24 breaths per minute, and the volume of air in one breath is 250 ml. An exact answer is unnecessary.

Step 1, breaths per day. At rest we take about 24 breaths per minute. So breaths per day are roughly $24 \times 60 \times 24 = 1440$. So breaths per day are roughly 1440 to 22 thousand, take about 20,000 breaths.



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Step 2, volume of one breath. It takes about 4 to 5 breaths to fill a typical rubber party balloon, which holds about 2 litres when inflated. So one breath is about **0.5 litre**.

Step 3, multiply. $20,000 \times 0.5 \text{ litre} = \text{about } 10,000 \text{ litres of air a day}$.

Step 4, check another way. One balloon can be blown up in about 20 s, so about 3 balloons a minute.

$(3 \text{ balloons / minute}) \times (2 \text{ litres / balloon}) \times (1440 \text{ minutes / day}) = 8640 \text{ litres / day}$.

For estimation purposes, 8640 litres is reasonably close to 10,000 litres, so the estimate is sensible. (Blowing balloons nonstop would tire us quickly, unlike normal restful breathing, so this check is only rough.)

Example 5: Approximate or exact (NCERT Pause and Ponder 2)

Question: Describe one situation where an approximate value is enough and one where you would need a very exact value.

Model answer:

- **Approximate is enough:** estimating how long the ride home will take. A rough figure is enough.
- **Exact value needed:** the fuel loaded into an aircraft. A small mistake left the aircraft about 15,000 litres short. A medicine dose is another case where precision is needed.

Example 6: Connecting branches

Question: Choose a real-life object (maybe a traffic jam near your school). Make connections with physics, chemistry, biology, earth science, or math. How do these branches of science connect with your example.

Model answer (pressure cooker), describe the connections:

- **Physics:** heat flows from the flame into the water, which raises the boiling point of water;
- **Chemistry:** cooking changes the substances in the food;
- **Biology:** cooked food is easier to digest.



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Connection: physics and chemistry work together: the higher pressure lets the water inside get hotter than 100 °C, and at this higher temperature the changes in food happen faster, so food cooks sooner.

Competency-Based Questions (with answers)

1. Source-based: Meghnad Saha

Source: "When physicist Meghnad Saha studied the light from stars, ... he treated the matter in the star as a hot gas, ignored many complex processes, and focused only on temperature, pressure, and how atoms formed ions."

(a) Which three quantities did Saha focus on? Temperature, pressure, and how atoms formed ions.

(b) What did this simplification allow him connected to their temperature.

(c) Which idea of the chapter does this sl model keeps only what matters for the que

2. Assertion-Reason

Assertion (A): Ignoring the spin of a crick

Reason (R): Assumptions in a model are m answering the question.

(i) Both A and R are true and R is the corre not the correct explanation of A. (iii) A is tr

Answer: (iv). NCERT calls such choices d in a simple model.

3. Assertion-Reason

Assertion (A): A scientific theory is an exp examination.

Reason (R): Scientific theories are final and cannot be questioned.



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Answer: (iii) A is true but R is false. NCERT states that no scientific theory is ever final and none is beyond question; theories change as new evidence becomes available.

4. Assertion-Reason

Assertion (A): Weather forecasts are usually reliable for a few hours or days but less certain further into the future.

Reason (R): Very tiny differences in conditions can grow over time and lead to something completely different.

Answer: (i) Both are true and R correctly explains A.

5. Case-based: Units at the fuel pump

An aircraft needs 22,300 kg of fuel. The ground crew uses the density of fuel in pounds per litre instead of kilograms per litre, and the aircraft needs about 15,000 litres of fuel.

(a) What kind of error caused the shortage (in kilograms).

(b) 1 kg is about 2.2 lb. If a mass value in pounds is overestimated or underestimated? Over or under?

than the kilogram figure for the same mass? Is your answer really is.

(c) What practice prevents such errors? I conversions.

6. Competency MCQ: Law, theory

Which statement is correctly matched?

- (a) Atomic theory: describes the jerk felt v
- (b) Newton's laws of motion: explain how i
- (c) Conservation of energy: a principle ap
- (d) A law: a guess that has not been teste

Answer: (c). The jerk in a bus goes with Newton's second theory, and a law describes an observed relationship.

A screenshot of a chat application. At the top, there is a dark blue header bar. On the left of this bar is a circular profile picture of a woman with dark hair, smiling. To the right of the profile picture, the name 'Ira' is written in white, bold font. Below the name, the text 'Your teacher for Exploration' is written in a smaller white font. The main area of the chat is white. On the left side of this area, there is a smaller circular profile picture of the same woman. To the right of this picture, there is a white speech bubble with a thin grey border. Inside the bubble, the text reads: 'Hi, I am Ira. I teach this syllabus all day, so Exploration is very much my home ground. Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:'. The word 'Exploration' is highlighted in blue. At the bottom of the screen, there is a light grey bar. In the center of this bar, the text 'Free questions, no login needed' is written in a dark grey font. Below this, in a smaller dark grey font, is the text 'AI generated, can make mistakes. Cross-check with NCERT.'

7. Data-based: Checking an estimate

Two students estimate the air breathed in a day. Riya: 15 breaths per minute, 0.5 litre per breath. Kabir: 12 breaths per minute, 0.5 litre per breath. Use 1440 minutes per day.

(a) Riya's estimate? $15 \times 0.5 \times 1440 = 10,800$ litres.

(b) Kabir's estimate? $12 \times 0.5 \times 1440 = 8640$ litres.

(c) Are both reasonable? Yes. Both fall close to NCERT's estimate of about 10,000 litres. For an estimate, answers this close count as agreeing.

8. Case-based: The eclipse message

A message says: "Food should not be eaten during an eclipse because it becomes harmful."

(a) What is an eclipse, in simple terms? A play of shadows.

(b) Write two scientific questions to test the message. (e.g., Does temperature change significantly during an eclipse? Does temperature change significantly during a shadow?)

(c) Conclusion? No physical, chemical or biological change can be rejected on evidence.



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Important Questions for

1-Mark Questions

Q1. Why is the speed of light denoted by c ?
It comes from the Latin word celeritas, meaning speed.

Q2. What is the value of the speed of light in vacuum?
Exactly 299792458 m/s.

Q3. In a model of a moving car used in physics, what is a point?
As a single point.

Q4. Name the principle applied when climbing stairs.
The principle of conservation of energy.

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2-Mark Questions

Q5. What is a model in science? Give one example from chemistry.

A model is a simplified way of looking at a real system that focuses only on what is most important for a given question. In chemistry, atoms and molecules are drawn as spheres and bonds.

Q6. Distinguish between a law and a theory.

A law usually describes a regular pattern observed in nature, e.g. Newton's laws of motion. A theory explains why those patterns occur, based on evidence gathered over time, e.g. the atomic theory explaining how molecules form.

Q7. Why does science need standard units? Give an everyday example.

Standard units let scientific results be compared and ensure fairness in daily life and trade. A kilogram of rice or vegetables means the same amount everywhere because it is based on an agreed international standard.

3-Mark Questions

Q8. "A theory is just a guess." Evaluate this statement.

The statement is wrong for science. A scientific theory is based on observation and critical examination of evidence. It remains a theory until more evidence becomes available. NCERT calls it a theory, not a guess, because it is reliable.

Q9. What happens when a scientific process becomes more useful?

Scientists re-examine their assumptions, re-evaluate the evidence. This drives further exploration and the scientific process improves.

Q10. Explain, with the example of the mask, how science is interdisciplinary.

Understanding a mask needs physics (properties of polymer fibres), biology (size of virus), and engineering (modelling airflow and filtration efficiency). Science has no such boundaries.

5-Mark Questions

Q11. What is a model? Why do scientists use models? Give two examples from NCERT and state how models are improved.



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A model is a simplified way of looking at a real system that keeps only what is most important for a given question. Scientists make assumptions because studying the natural world in full detail is often impossible. Examples: (1) when studying a falling object, air resistance may be neglected to understand the basic effect of gravity; (2) when studying how the heart pumps blood, individual cells are ignored so the heart is understood as a functioning organ. These choices are deliberate simplifications. Models are improved by adding extra details, such as air resistance or the spin of a ball, when greater accuracy is needed.

Q12. Explain the difference between a law, a theory and a principle with one example each.

Why are these ideas said to be “open to improvement”?

A law describes a regular pattern observed in nature (Newton’s laws of motion explain the jerk when a bus stops suddenly). A theory explains why patterns occur, based on evidence available at the time (atomic theory explains how molecules are formed). A principle is a broad idea applied to a situation (conservation of energy when climbing stairs). They are open to improvement because they often change as new evidence appears; even successful theories may fail under new conditions or more precise measurements.

Common Mistakes and Explanations

1. **Mistake:** Calling the ignored details of a model a “simplification” on purpose to keep things simple while ignoring the purpose. **Fix:** A model is a simplified way of looking at a real system that keeps only what is most important for a given question.
2. **Mistake:** Swapping the examples, e.g. “jerk in a bus” for “conservation of energy”. **Fix:** Jerk in a bus = Newton’s laws; molecules = atomic theory; conservation of energy = principle.
3. **Mistake:** Writing that a law explains why something happens, e.g. “Newton’s laws explain the jerk in a bus”. **Fix:** Law describes the pattern, not the cause. “Newton’s laws describe the pattern of motion when a bus stops suddenly.”
4. **Mistake:** Writing “a principle” and “a law” interchangeably. **Fix:** A law describes a regular pattern observed in nature, a principle is a broad idea applied to a situation, such as conservation of energy.
5. **Mistake:** Saying scientific theories are “proven” or “final”. **Fix:** Scientific theories are explanations based on evidence, but they are always open to improvement as new evidence appears.
6. **Mistake:** Saying c stands for “constant” or “speed of light”. **Fix:** In the context of the syllabus, c stands for “constant” or “speed of light”.
7. **Mistake:** Dropping units in an estimate, e.g. “The volume of the balloon is 1000”. **Fix:** Write each factor with its unit (balloons are inflated with air at 1000 litres per day) and show that the answer is in litres per day.



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8. **Mistake:** Chasing an exact figure in an estimation question. **Fix:** Use round numbers, state them clearly, and check the answer is reasonable.
9. **Mistake:** Answering a “make it testable” question with yes/no questions. **Fix:** Ask about measurable data and past patterns: humidity, wind speed and direction, temperature trend.
10. **Mistake:** Rejecting the eclipse claim with “it is superstition” alone. **Fix:** Give the scientific questions (what physical change occurs, does temperature change, does food spoil in shadow) and conclude that no physical, chemical or biological mechanism supports it.

Quick Revision Points

- Secondary-stage science asks how we know, as well as what we know.
- A model is a simplified view of a real system that keeps only what matters for a given question.
- Models: car as a point, atoms as sphere, layered sphere.
- Assumptions are deliberate: air resistance ignored when studying the heart.
- Cricket six: keep mass, speed and direction (simple model) spin, seam and air resistance.
- Meghnad Saha treated a star’s matter at high temperature.
- Symbols: m (mass), v (velocity), F (force) exactly 299792458 m/s).
- Standard units allow comparison of results.
- Aircraft fuel incident: 22,300 kg needed. Use SI units everywhere.
- An equation is a compact statement of a relationship.
- Order for problems: understand the situation, then use mathematics.
- Law describes a pattern; theory (a tested model) applied to a situation.
- Prediction fails: re-examine assumption.
- Weather forecasts lose accuracy with time because tiny differences grow.



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- No scientific theory is final; ideas are rejected only on evidence.
- Eclipse claim: an eclipse is a play of shadows; no mechanism makes food harmful.
- Air breathed per day $\approx 10,000$ litres (check: 8640 litres by the balloon method).
- Branches of science are human divisions; real problems (climate change, medicines, masks) need several together.

Weightage and Exam Pattern

Class 9 has no board exam. This chapter is assessed in your school's own exams, and the chapter gives no marks allocation. It has no end-of-chapter exercises, so its examples, Pause and Ponder prompts and boxed stories are the natural source of questions. Likely types:

- one-line definitions: model, law, theory, principle;
- short reasoning answers: why assumption theory counts as a tested explanation;
- case-based questions built on the cricket eclipse claim;
- simple estimation problems like the air I

It is also the foundation for Class 10 board understanding the situation, listing quantities reasonable.



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