# Deyes High School Curriculum Rationale
# Science

## Overarching curriculum, intent for Science

To provide students with the powerful knowledge in Science that will promote social mobility, deepening students' knowledge and understanding of scientific concepts and vocabulary through consistent teaching approaches supported by evidence.

To develop students' curiosity and excitement for science through scientific enquiry and development of practical investigation skills.

To make use of sophisticated interleaving of knowledge, practical, literacy and numeracy skills in order to allow students across the ability range to revisit and build on prior knowledge which will support them to transfer information into long term memory, improving retention of knowledge and depth of understanding,

To develop students' understanding of the importance of science in the world around us and inspire the next generation of scientists, medics and engineers.

| | Content Taught | Rationale |
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| **YEAR 7** | **Physics**<br>*Energy* | This unit is the first-time pupils will encounter energy as a phenomenon. It provides the fundamentals and underpins the knowledge needed for other topics in KS3. During this unit, pupils will be taught the Law of Conservation of Energy, that energy cannot be created or destroyed. Pupils will investigate the energy in food through scientific enquiry, and evaluate the reliability of the methods used, suggesting possible improvements. |
| | **Chemistry**<br>*The Particle Model* | During this unit, pupils will look at the properties of the different states of matter and changes of state with regards to the particle model. Pupils will |

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| | | look at the concept of pure substances and investigate the melting and freezing points. States of matter builds up on the idea of kinetic energy of particles from the Energy unit. |
| | **Biology**<br>*Cells* | During this unit, pupils will build on their prior knowledge from Year 6, and will learn that cells are the fundamental unit of living organisms. Pupils will investigate how to extract, observe, interpret and record cell structures with the aid of a light microscope. Pupils will apply this knowledge to the hierarchical organisation of multicellular organisms: from cells to tissues to organs to organ systems. Pupils then move on to the structure and functions of the human skeleton and muscles with the aid of models. |
| | **Physics**<br>Earth & Universe | During this unit, pupils will look at models to represent the solar system consisting of planets orbiting the Sun, moons orbiting planets and sunlight spreading out and being reflected. Pupils will build on this to explain day and night and seasons. Pupils will look beyond our solar system, and look at how long it takes light from other stars and galaxies to reach Earth. Pupils will look at the magnetic poles of the Earth, investigating the magnetic field using investigating skills. This unit it taught when the nights are darkest, allowing pupils to use their learning of stars from lessons at home. |
| | **Biology**<br>*Digestion* | During this unit, pupils will learn that the body needs a balanced diet in order for cells' energy, growth and maintenance. Pupils will investigate how to test for specific nutrients within different foods and present observations using appropriate methods. Pupils are also taught how the different organs of the digestive system are adapted to break large food molecules into smaller ones which can travel in the blood to the cells and are used for life processes. |
| | **Chemistry**<br>*Atoms, Elements and Compounds* | During this unit, will start to use the periodic table, particle diagrams and models to classify substances as elements, compounds and mixtures. Pupils |

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| | | will investigate different chemical reactions and distinguish physical reactions from chemical reactions. |
| | **Biology**<br>*Reproduction* | During this unit, pupils will build on what was taught in the first Biology Unit; Cells. Pupils will look at mammalian reproduction, content not covered at KS2 Science. There will be a larger focus on the structure and function of the male and female reproductive systems. Pupils are taught how the menstrual cycle prepares the female for pregnancy and how the developing foetus relies on the mother to provide it with oxygen and nutrients, and to remove waste, and protecting it against harmful substances. Pupils will develop an understanding of how the fertilised egg cell goes to foetus. |
| | **Physics**<br>*Electricity* | During this unit, pupils will build on prior knowledge at KS2 looking at electricity. Pupils will now investigate the current, potential difference and resistance in both series and parallel circuits. Pupils will also investigate the magnetic field of current and electromagnets. |
| | **Chemistry**<br>*Separation Techniques* | During this unit, pupils will build on their understanding from the first Chemistry topic. Pupils will apply their knowledge of the particle model and kinetic theory to how substances are separated. Pupils will learn to develop how to plan and carry out scientific enquiries to test predictions, including identifying independent, dependent and control variables. Pupils will use simple techniques for separating mixtures including: filtration, evaporation, distillation and chromatography. |
| **YEAR 8** | **Biology**<br>*Photosynthesis* | During this unit, pupils will build their knowledge and understanding from what they had learnt in Year 7. Pupils will apply prior knowledge from Cells and Chemical Reactions from Year 7 to understand that the dependence of almost all life on Earth comes from photosynthetic organisms. |
| | **Physics** | |

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| | *Light and Sound* | During this unit, pupils will build on what they have been taught at KS2 with regards to Light and Sound. Pupils will explain observations of how sounds travels using the idea of a longitudinal wave, and light travels as a transverse wave. Pupils will use apparatus such as an oscilloscope to demonstrate the amplitude and frequency of waves, and how sound waves change with volume or pitch. Pupils will also look at light waves to investigate how light is reflected and refracted as it moves through different mediums. |
| | **Chemistry**<br>*The Periodic Table* | During this unit, pupils will build on their knowledge from Year 7. Pupils will look at how the Periodic Table has changed over time and the scientists involved in these changes. Pupils will investigate the reactivity of the elements in the different groups of the periodic table, and looks for patterns and trends. |
| | **Biology**<br>*Respiration* | During this unit, pupils will learn that respiration is a series of chemical reactions in cells that break down glucose to provide energy and form new molecules. Pupils will compare the difference between aerobic respiration and anaerobic respiration during this topic with the use of investigation skills. Pupils will use models to demonstrate gas exchange between alveoli and blood after looking at the structure and function of the breathing system. |
| | **Chemistry**<br>*Chemical Reactions* | During this unit, pupils will develop their understanding further on chemical reactions from what they had been taught in Year 7. Pupils will now begin to give examples and explain whether reactions are combustion, thermal decomposition, oxidation, or displacement. Pupils will be able to make predictions of the products formed during a chemical reaction, and explain observations about the change in mass of reactants and products. |
| | **Physics**<br>*Matter* | During this unit, pupils will build on their prior knowledge in Year 7 to explain the differences in arrangements, in motion and in closeness of particles explaining changes of state with regards to internal energy. Pupils will look at similarities and differences including density between the |

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| | | different states of matter. Pupils will look at the history of explaining particle movement in gases, and the work that Robert Brown conducted to explain Brownian motion. |
| | **Biology**<br>*DNA & Inheritance* | During this unit, pupils will build on their knowledge from Cells in Year 7. Pupils will look at the make up of the nucleus, looking at models of chromosomes and DNA. Pupils will look at the work carried out by Watson, Crick, Wilkins and Franklin in the development of the DNA model.<br>Pupils will study the variation which can drive natural selection.<br>Pupils will look at the importance of maintaining biodiversity and the use of gene banks to preserve hereditary material. |
| | **Chemistry**<br>*Acids & Alkalis* | During this unit, pupils will be introduced to a new concept of Science, something which is not taught at KS2. Pupils learn what the pH scale is, and investigate the strength of different acids and alkalis. Pupils will be able to apply their knowledge from the Chemical Reactions topic to name salts during a neutralisation reaction. |
| | **Physics**<br>*Forces & Motion* | During this unit, pupils will build on their prior knowledge from KS2 when they looked at the effects of air, water resistance and friction that act between moving surfaces. During this unit, pupils will look at forces being needed to cause objects to start or stop moving, or to change their direction of motion. Pupils will use investigative skills to interpret observations and data, including identifying patterns. Pupils will be using mathematical skills during this unit to use and re-arrange formula to carry out calculations. |
| **YEAR 9** | In Year 9, students begin the fundamental topics of AQA GCSE. All topics are found on both the combined science trilogy as well as the separate sciences.<br><br>**Biology** | The first topics are designed to link the KS3 national curriculum to the foundation topics in GCSE, providing an important bridge between both key stages. In year 9, subject specialists teach their own subject so pupils learn the important knowledge and skills to begin their GCSE. |

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| | *Cell Biology, including cells and microscopy, cell division and cell transport* | Cells are the fundamental building blocks of life and this this initial GCSE unit provides the bases for understanding biology. During this unit, pupils will build on what was taught in Year 7 and 8 with regards to cells. Pupils will explore the structural differences between types of cells and how this allows them to perform specific functions within the organism.<br>Pupils will use appropriate apparatus, techniques and magnification, including microscopes, to make observations of biological specimens and produced labelled scientific drawings. |
| | *Digestive and circulatory systems* | Following the initial unit, pupils move on to understanding how the function of cells work in the human body within the digestive and circulatory systems. Pupils learn about how the breakdown of carbohydrates, proteins and fats into small soluble substances are be absorbed into the blood, to develop a vital understanding of the human body. Pupils also learn about the practical applications of the circulatory system and how coronary heart disease can be treated. |
| | *Non-communicable disease* | Pupils then use their prior learning from the previous units to support the development of understanding in the non-communicable disease unit. This unit focuses upon diseases such as cancer and heart disease and the treatments that are used to help those with these diseases. This then leads onto pupils studying the communicable diseases unit when they enter year 109. |
| | **Chemistry**<br>Atomic Structure and The Periodic Table | The atomic structure topic builds on knowledge gained throughout Key Stage 3. The unit provides fundamental concepts that underpin the rest of the course.<br><br>The periodic table provides chemists with a structured organisation of the known chemical elements from which they can make sense of their physical and chemical properties. The historical development of the periodic table and models of atomic structure provide good examples of how scientific ideas and explanations develop over time as new evidence emerges. The arrangement of elements in the modern periodic table can be explained in |

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| | | terms of atomic structure which provides evidence for the model of a nuclear atom with electrons in energy levels. |
| | Bonding, Structure and the Properties of Matter | This unit is taught second as students' needs to have secure knowledge of atomic structure in order to understand the concepts taught in this unit.<br><br>Chemists use theories of structure and bonding to explain the physical and chemical properties of materials. Analysis of structures shows that atoms can be arranged in a variety of ways, some of which are molecular while others are giant structures. Theories of bonding explain how atoms are held together in these structures. Scientists use this knowledge of structure and bonding to engineer new materials with desirable properties. The properties of these materials may offer new applications in a range of different technologies. |
| | Quantitative Chemistry Part 1 | Quantitative chemistry is taught as an introduction to the essential calculations in chemistry. Calculations are assessed in both paper one and paper two therefore students gain confidence in their ability early on in the course, then practised throughout year 10 and 11. Mathematical skills are key for full understanding of chemistry, therefore this unit has been brought forward to the end of year 9.<br><br>Students will use quantitative analysis to determine the formulae of compounds and the equations for reactions. Students use quantitative methods to determine the purity of chemical samples and to monitor the yield from chemical reactions, leading on to identifying different types of chemical reaction. Chemical equations provide a means of representing chemical reactions and are a key way for chemists to communicate chemical ideas. |
| | **Physics**<br>Energy | During this initial unit, pupils will develop their prior knowledge from KS3. Energy is studied first as it is the most fundamental area of physics. Pupils will learn new maths skills and have to use and apply formula that will be required throughout the rest of the GCSE course. |

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| | Electricity<br><br>Wave Properties and EM Spectrum | The electricity topic builds on both the understanding of electrical energy from the GCSE energy topic as well as prior knowledge and skills of the KS3 electricity topic. Pupils will lean about new components that are used in everyday electrical devices and understand the processes behind them. Pupils develop practical skills that perform an ideal basis for any career in electrical engineering and also the foundation of the later topic in year 10 domestic electricity.<br><br>During this unit, students will develop their understanding of energy transfers as waves. Student will learn to measure waves and find out about the electromagnetic spectrum. Waves is a fundamental unit that provides an excellent basis for building skills such as using standard form and re-arranging equations. This allow student to enter year 10 will the skills and ability for the more difficult topics in year 10. |
| **YEAR 10** | Students can follow 2 pathways;<br><br>• **AQA Combined Science Trilogy** (8464) leading to 2 GCSEs in Science<br>• **AQA GCSE Separate Science in Biology** (8461), **Chemistry** (8462) & **Physics** (8463) leading to 3 Science GCSEs.<br><br>**Biology**<br>Communicable disease<br>Plants and photosynthesis<br>Respiration<br>Nervous system coordination<br>Hormonal coordination<br>Adaptation, competition and interdependence<br>Ecosystem organisation<br>Biodiversity and human impact | Topics are delivered to broadly follow the AQA scheme of work with a few topics brought forward or split in to 2 smaller topics. This is to allow students to gain foundations of core knowledge and then revisit topics later. This allows students to improve and build on their initial knowledge and skills to develop deeper understanding of the scientific world.<br><br>All KS4 schemes of work and lessons have key skills built into them, always linked to careers and real life applications. We offer a broad curriculum base where students gain knowledge beyond the curriculum in order to build their cultural capital. We focus on recall of knowledge and it's application, Required Practicals and evaluating data, and mathematical skills. It is these three elements which are assessed in final examinations at the end of Year 11.<br><br>***Mathematical Skills***<br>Topics regularly test analysis of graphs and data, allowing students to develop their evaluation skills and build on the foundation of knowledge and skills from year 9. There is a big emphasis on pupils learning mathematical formula, and being able to re-arrange to apply to a real life scenario. Pupils |

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| | **Chemistry**<br>Chemical changes<br>Energy changes<br>Rate and extent of chemical change<br>Organic chemistry<br><br>**Physics**<br>*Applications of waves (separates only)*<br>Particle model of matter<br>Forces<br>Atomic structure<br>*Fission and fusion (separates only)*<br>Domestic electricity | are required to be able to learn this skill across all three sciences; Biology, Chemistry and Physics.<br><br>***Required Practicals***<br>Throughout KS4, pupils carry out a number 'Required Practicals' within Biology, Chemistry and Physics. Pupils will focus on writing hypothesis, variables, analysis and interpretation of graphs and data, conclusions and evaluation skills.<br>There is a big emphasis on learning these Required Practicals, and pupils build up a folder during KS4, keeping a detailed record.<br>During the final examinations at the end of Year 11, any of these Required Practicals could be referred to, and pupils should be expected to apply their knowledge from these to their exam.<br><br>***Recall of Knowledge***<br>With the high demand from the new GCSE examinations, there is a big focus on pupils being able to retrieve and recall key facts to apply to their examination answers. Schemes of work are thoroughly resourced to provide pupils with abundant opportunities to learn these key facts. Pupils will regularly be quizzed on these key facts of knowledge, not only from current topics, but from topics throughout all of KS4. Regular application of the facts are built in to lessons to allow students to adapt their skills to real life. |
| **YEAR 11** | **Biology**<br><br>Inheritance<br>Variation, evolution and classification<br><br>**Chemistry**<br>Chemical analysis<br>Chemistry of the atmosphere<br>Using resources<br><br>**Physics**<br>Mechanics<br>*Further mechanics (separates only)* | Students complete the final topics of their GCSE. The majority of topics are considered to be the most challenging, building on the knowledge and skills gained during year 9 and 10, therefore reinforcing prior understanding.<br><br>After completion of the final topics, students will begin a series of revisit lessons where they will go over the whole GCSE course again to prepare them for examination in the summer. Revisit lessons are designed to develop students recall of knowledge and learn to apply it to answer exam questions. |

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| | Magnetism and electromagnetism<br>*Astrophysics (separates only)*<br><br>Revisit of all content starting approx. February of year 11. | |
| **KS5** | We offer 4 courses at Key Stage 5<br><br>• AQA A Level Biology<br>• AQA A Level Chemistry<br>• AQA A Level Physics<br>• EDEXCEL BTEC Applied Science specialising in medical science | |
| **Year 12** | A-Level Biology AQA | The qualification is delivered by specialist biology teachers who deliver different aspects of the course concurrently.<br><br>The first units covered by students are cell structure and biological molecules. This builds upon the students understanding of the cells as the fundamental building block of life and the foundation of all living systems. Whilst at the same time students begin to learn some of the basic chemistry of life. This knowledge of biomolecules underpins subsequent topics such as DNA replication and protein synthesis and cell transport.<br><br>The study of DNA leads into the application of genetics and variation, which then leads into classification and ecological diversity.<br><br>The Study of cell membranes leads onto the students learning who parts of the membrane play a role in cellular recognition and communication, and then this concept as the fundamental ideas that the immune system is based on.<br><br>The cell membrane plays a vital role in exchange and this leads onto the study of mass transport in plants and animals. |

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| Year 13 | A-Level Biology AQA | In year 13 the study of biomolecules from Yr12 is the underlying knowledge that is applied to bioenergetics. The idea flow of energy between organisms is developed into the flow of energy and nutrients within larger ecological systems. The final portion of this side of the A-level links ecology with the genetics from year 12 to link genetics, populations and evolution.<br><br>Transport across a cell membrane is the fundamental idea behind transmission of the nerve impulse which is studied at the start of Year 13. Nervous control is an introduction to homeostatic mechanisms. The final unit is the control of gene expression which complements the genetics taught last in the other half of the specification. This final topic bring students up to date with some of the most modern developments in Biology and Genetic engineering. |
| **Year 12** | **A Level Chemistry AQA**<br>Physical Chemistry<br><br>Inorganic Chemistry<br><br>Organic Chemistry | Students begin with fundamental Chemistry in the form of Atomic Structure. This builds on the GCSE Knowledge and allows them to apply their understanding to bonding, amount of substance, equilibria and redox equations. We follow the order put forward by the exam board as this allows for a development of the literacy, numeracy and examination skills to allow them to access the second year of the course.<br><br>Students study inorganic Chemistry in parallel lessons with a second teacher. This begins with periodicity which provides the students with a detailed overview of the periodic table and allows them to predict properties based on their location. This then allows them to access the group 2 and 7 content.<br><br>After inorganic, students begin on the Organic Chemistry section which begins with naming molecules and then progresses through a variety of simple organic reactions and mechanisms as a foundation to year 2. Analysis of organic molecules is also undertaken, using spectroscopy as an application of the reactions and molecules investigated to date on the course. |
| **Year 13** | **A Level Chemistry AQA**<br>Physical Chemistry | Students use the skills and knowledge from their initial introduction to allow them to access further, more complex physical Chemistry topics. This |

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| | Organic Chemistry<br><br>Inorganic Chemistry | includes Thermodynamics and rate equations which build from energetics and equations, Kp which is further application of equilibria and electrochemical cells which see the application of redox reactions. Acids and bases also uses the students' knowledge of amount of substance and applies this to highly complex calculations, addressed at the end of the course with this teacher as the summation of physical Chemistry.<br><br>Similarly in organic Chemistry, more complex mechanisms and reactions are addressed with applications of carbonyls, aromatic compounds and DNA, all using skills and ideas developed during year 1. Furthermore, organic analysis is build on, using more complex techniques such as H' and C NMR.<br><br>Inorganic Chemistry then can develop the students' understanding of the transition metals and period 3. This will allow the students to understand reactions of metals and their ligands, not possible without extensive knowledge of co-ordinate bonds or charges within ligands. |
| **Year 12** | **A Level Physics AQA (and AS)**<br>Measurements and errors<br><br>Particles and quantum physics<br>Mechanics and materials | A Level Physics in year 12 is split between specialist teachers. Students start with an introductory unit that covers the basic skills for practical's and mathematical analysis. Both teachers teach essential practical and mathematical skills in this short topic before moving on to the main content for the year.<br><br>Pupils will start with both Particles and quantum physics and Mechanics and materials in year 12. Each taught by a separate teacher. Particles and quantum physics are both brand new and interesting topics which students generally enjoy. There is a lot of learning facts in these topics and this allows students to get to grips with the expectations of the A Level course. Alongside this, the topic of mechanics is challenging which is an essential unit to develop higher level maths skills that are required throughout the whole A Level. |

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| | Waves<br>Electricity | Waves and Electricity are the final 2 topics in the year 12 course. In waves, students learn about wave properties and how they apply to the real world. They will learn about refraction, diffraction and how total internal reflection is utilised in optical fibres. In electricity, pupils will develop high level circuit building skills and apply Kirchhoff's Laws to circuit problems. Both topics complete the full AS level course, if this path is chosen. |
| **Year 13** | **A Level Physics AQA**<br>Thermal physics<br>Further mechanics<br><br>Gravitational, electric and magnetic fields<br>Capacitance<br><br>Nuclear Physics<br>Astrophysics<br><br>Measurements and errors | In year 13, students utilise the skills and knowledge from year 12 to complete 7 new units as well as the optional unit. They are taught in the order that is set out by AQA in the specification and generally grow in their difficulty (and relative importance for the exam) as the year progresses. Thereby, the units that have a higher weighting in the exam are taught more closely to the exam.<br><br>We end the year with a reminder of the measurements and errors topic that began the whole course. This is to enhance the preparation for paper 3 which provides a full circle of skills, which will also have been developed during the many practicals taking place throughout the course.. |
| **Year 12** | **BTEC Foundation Diploma in Applied Science**<br><br><br><br>**Unit 1** | Students cover only externally assessed exam content during year twelve, split into two units. The students complete the Foundation Diploma qualification as this increases the amount and the weighting of the coursework part of the course, minimising exam pressure and allows the students to receive a qualification worth 1.5 A Levels.<br><br>Unit 1 comprises of a Biology, Chemistry and Physics section. The course begins with the Biology content as this is their first exam. The students look primarily at cells' structure, function and specialisation followed by an in depth look at tissues, including epithelial, endothelial, muscle and nervous tissues' structure, function and effects of diseases and treatments. |

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| | | The Chemistry aspect looks in detail at the atomic structure covered at GCSE. It looks in more depth, including electronic orbitals, intermolecular forces and coordinate bonds. The course then moves on to the properties of these substances due to their location on the periodic table and their electron arrangements.<br><br>The Physics part of the course looks in detail at waves, building on the GCSE knowledge to look at more applications such as diffraction gratings, waves within different types of musical instruments and endoscopes. The course then focuses in detail on evaluating different ways electromagnetic waves are used in communication, i.e. in mobile phones, Bluetooth®, infrared and Wi-Fi. |
| | **Unit 3** | Unit 3 runs parallel with unit 1, and covers the practical skills required in a Science course. The students take significant time developing their graph and method writing skills to improve to a Level 3 standard and evaluate a whole range of practicals undertaken by others. This builds on their expertise in the lab and prepares them for the practical exam later in the year.<br><br>The topics covered during the unit range through Biology, Chemistry and Physics. The course units are covered in an order so as to build up the expertise of the students, with increasing difficulty in the statistical calculations that go along with it and the difficulty in the topic itself. Primarily the students look at enzymes, then diffusion, energy content in fuels, electrical cells and then plants and their environment. This allows the students to gain in confidence in their ability to use statistics to proffer ideas, conclusions and evaluation of experiments. |
| **Year 13** | Unit 2<br><br>Unit 8 and 9 | Unit 2 is a coursework based unit, assessed internally. This builds on the skills students have gained during unit 3 and applies it to titrations, colorimetry, chromatography and cooling curves. Each technique requires expert technical skill and an ability to analyse and evaluate high level practical methods. |

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| | Unit 4 | Following on from unit 2, the students research a number of body systems, look in detail at the physiology and diseases affecting them. The students then evaluate each treatment for each of the diseases and draws conclusions from extensive research on the system.<br><br>Unit 4 requires the students to undertake an in depth analysis of Pfiser, a company which produces drugs and chemicals. This analysis requires the students to understand the key health and safety concerns in different parts of the business. Following this, the students follow a complex method and produce aspirin and acetone through organic synthesis. This builds on their ability to perform a practical from both unit 3 and 2. The students are then able to research how these techniques are done on a larger scale and they produce a detailed comparison of the different methods. |
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