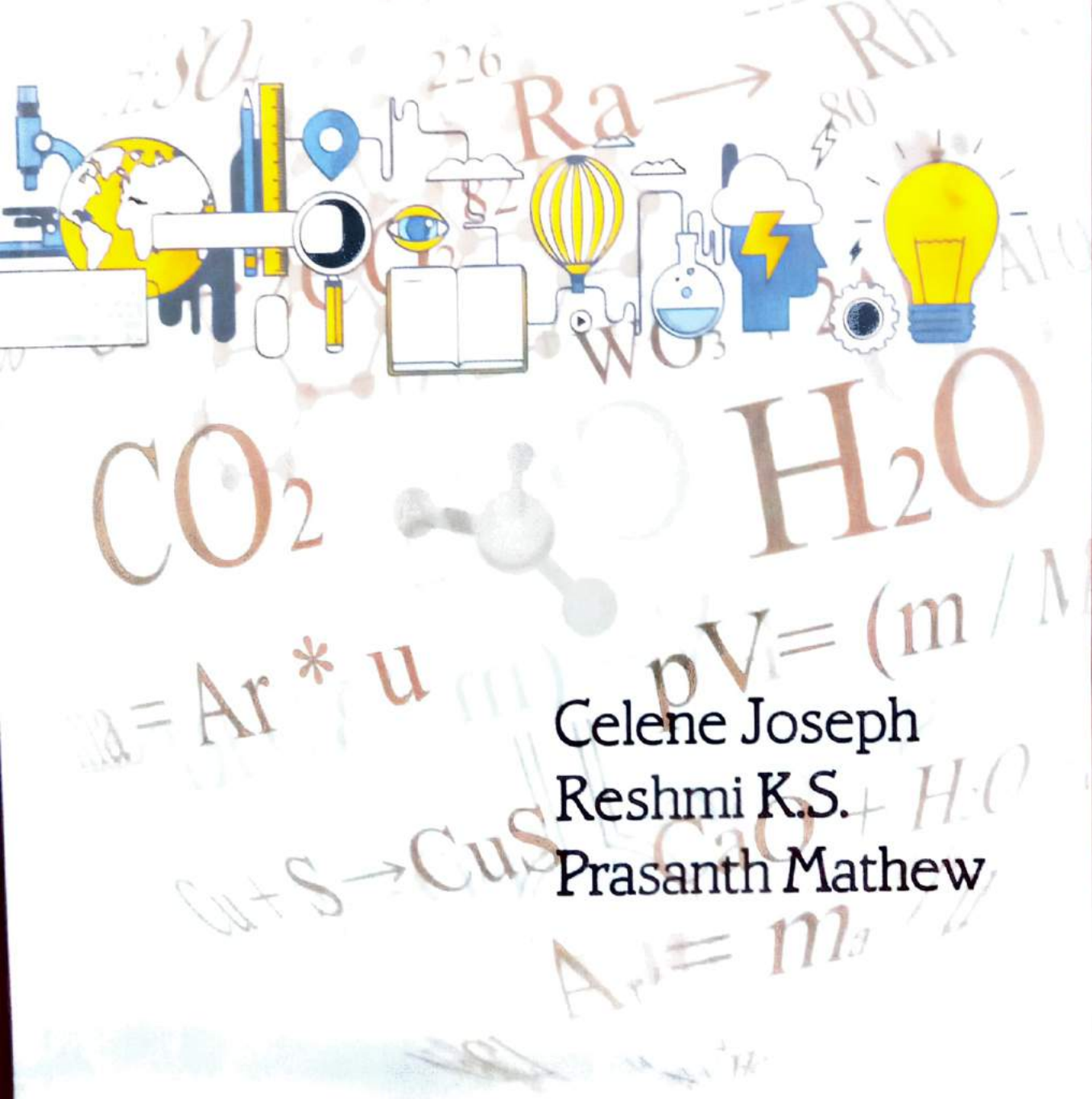


Science Education

Concepts and Pedagogy



Celene Joseph

Reshmi K.S.

Prasanth Mathew

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of the copyright holder.

The views and opinions expressed in this book are author(s) own and the facts reported by him/her have been verified to the extent possible, and the publishers are not in any way liable for the same.

Rs. 450; US\$ 18

ISBN: 978-93-91978-03-7

First Published in India in 2022

Science Education: Concepts and Pedagogy

© Dr Celene Joseph, Dr Reshmi K.S. and
Dr Prasanth Mathew

Published by:
SHIPRA PUBLICATIONS
LG 18-19, Pankaj Central Market
I.P. Ext., Patparganj, Delhi 110092, India
Tel.: +91 11 2223 5152/6152, 9650028065
E-mail: info@shiprapublication.com
www.shiprapublication.com

Contents

<i>Preface</i>	v
1. Nature of Science	1
1.1 Science: Meaning and Definition	1
1.2 Nature of Science	2
1.3 Impact of Science and Technology on Society	11
1.4 Scientific Literacy/Scientific Capability	12
1.5 Implications of Nature of Science for the Science Teacher	15
2. Science and Scientists in History	17
2.1 Science in Ancient Period	17
2.2 Science in Dark Ages	22
2.3 Science in Middle Ages	22
2.4 Science in Modern Period	22
2.5 Science in Modern India	25
2.6 Famous Scientists and their Contributions to Physical Science	25
2.7 Famous Indian Scientists	31
3. Development of Science Education	37
3.1 Science Education in Ancient Times	37
3.2 Science Education in Modern Period	37
3.3 History of Science Teaching in India	39
3.4 Development of Science Education in India after Independence	40
3.5 National Curriculum Framework (2005)	46
3.6 Kerala Curriculum Framework (KCF) 2007	48
4. Scientific Method	53
4.1 Science and Philosophy	53
4.2 Modern Concept of Scientific Method	54
4.3 Scientific Method: Definition and Steps	54
4.4 Elements of Scientific Method: Logical and Technical Aspects	56
4.5 Scientific Method and Transfer of Training	69
4.6 Application of Scientific Method to the Teaching of Physical Sciences	70
5. Importance of Science in the School Curriculum	71
5.1 Values/Functions of Science Teaching	71
5.2 Developing Scientific Attitude	74
5.3 Training in Scientific Method	74
5.4 Integrating Life Skills in Science Teaching	75
6. Concept of Correlation in Science Teaching	78
6.1 Need and Significance of Correlation	78
6.2 Types of Correlation	79
6.3 Advantages of Correlation	80
6.4 Classification of Correlation	81

		85
7.	Aims and Objectives of Science Teaching	
7.1	Concept of Aims in Teaching Science	85
7.2	Concept of Objectives in Teaching Science	88
7.3	Objective based Instruction and Evaluation	90
7.4	Taxonomy of Educational Objectives	91
7.5	NCERT Model of Classification of Objectives	107
7.6	Taxonomy of Science Teaching (Mc Cormack and Yager)	111
7.7	Integrated Taxonomy	116
7.8	Developing Scientific Capability: As the Objective of Science Education (SCCC, 1996)	119
8.	Science Curriculum	121
8.1	Concept of Curriculum	121
8.2	Purposes of Curriculum	122
8.3	Foundations of Curriculum Development	123
8.4	Curriculum Development	123
8.5	Curriculum Organisation	124
8.6	Characteristics of Good Curriculum Organisation	125
8.7	Principles of Curriculum Organisation	126
8.8	Aspects of Curriculum Organisation	127
8.9	Hidden Curriculum	135
8.10	Curriculum Mapping	136
8.11	Curriculum Integration	137
8.12	Curricular Innovations in India and Abroad	138
8.13	Major Features of Present Day School Curriculum	144
9.	Approaches to Science Teaching	147
9.1	Teacher Centred Vs. Student Centred Approaches	147
9.2	Process Vs. Product Approach	147
9.3	Inductive Vs. Deductive Approach	148
9.4	Integrated Approach	149
9.5	Conceptual Vs. Factual Approach	149
9.6	Inquiry and Discovery Approaches	149
9.7	Constructivist Approach	151
9.8	Issue based Approach	154
9.9	Critical Pedagogy	157
9.10	Self-Directed Learning	160
9.11	Cooperative Learning	161
9.12	Collaborative Learning	165
9.13	Homogeneous/Heterogeneous Grouping	167
9.14	Differentiated Instruction/Differential Teaching	170
9.15	Enrichment Programme to Talented Students	171
9.16	National Science Talent Search Scheme	172
10.	Instructional Methods	175
10.1	Lecture Method	175
10.2	Direct Instruction	181
10.3	Demonstration Method	182
10.4	Lecture-Cum-Demonstration Method	184
10.5	Developmental Method	188
10.6	Laboratory Method	189
10.7	Heuristic Method	193
10.8	Project Method	197
10.9	Problem Solving Method	205
10.10	Assignment Method	210
10.11	Role Play	217
10.12	Historical/Biographical Method	219
10.13	Discussion Method	220

	359
16. Evaluation in Science Teaching	359
16.1 Achievement Tests	360
16.2 Construction of a Good Achievement Test	364
16.3 Type of Test Items	366
16.4 Validity and Reliability to be Ensured for Achievement Test	370
17. Science Teacher : Qualities and Responsibilities	370
17.1 General Qualities of a Science Teacher	372
17.2 Duties and Responsibilities of a Science Teacher	373
17.3 Professional Development	373
17.4 Need for In-Service Training	375
17.5 Teacher Accountability: Need for Professionalism	375
17.6 Teacher Competencies	378
17.7 Teacher as a Facilitator	378
17.8 Teacher as a Social Resource	379
17.9 Teacher Research	383
<i>References</i>	383

This book advances a sequential theoretical framework of science education in a comprehensive manner. It offers specific, distinct and clear explanation of the key concepts of science education.

The book addresses four distinct aspects of Science Education, viz. how Science Works, how to design Pedagogical Processes in Science Teaching, how to make use of Resources and how to assess progress in Science Learning. The book is also an attempt to attain Quality Education, the fourth goal of UNSDGs.

It is a perfect guideline and a reference material for Researchers, Teacher Educators and Student Teachers at the graduate and post graduate levels in science education.

Dr (Sr) Celene Joseph is former Principal of St Thomas College of Teacher Education, Pala, affiliated to Mahatma Gandhi University, Kerala. She has twenty-seven years of teaching experience in Science Education. She has guided PhD researches and published books and articles nationally and internationally.

Dr Reshmi K.S. is working with Kerala University College of Teacher Education, Nedumangad, Trivandrum as Assistant Professor. She has eighteen years of teaching experience in Science Education and has published articles in Science Education.

Dr Prasanth Mathew, Assistant Professor of Physical Science & Vice Principal, PKM College of Education, Madampam, affiliated to Kannur University, Kerala, has teaching experience of twenty years. He is guiding PhD researches and has undertaken various research and extension projects of Central and State Government agencies. and has published International Articles.

ISBN: 978-93-91978-03-7

Rs 450; US\$ 18



Shipra Publications

LG 18-19, Pankaj Central Market
IP Ext., Patparganj, Delhi 110092, India
Tel.: +91 11 2223 5152/ 6152, 96500 28065
Email: info@shiprapublication.com
www.shiprapublication.com

ISBN 978-93-91978-03-7



9 789391 978037

₹ 450; US\$ 18