Title 7: Education K-12

Part 67: Polymer Science

2015 Polymer Science

Mississippi Department of Education

Program CIP: 15.0607 Plastics and Polymer Engineering Technology/Technician

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The Research and Curriculum Unit (RCU), located in Starkville, MS, as part of Mississippi State University, was established to foster educational enhancements and innovations. In keeping with the land grant mission of Mississippi State University, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

Table of Contents

Acknowledgments

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Dr. Carey M. Wright, State Superintendent of Education
Dr. John R. Kelly, Chair
Mr. Richard Morrison, Vice-Chair
Dr. O. Wayne Gann
Mrs. Kami Bumgarner
Mr. William Harold Jones
Mr. Charles McClelland
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Mr. Danny J. Spreitler
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Also, special thanks are extended to the teachers who contributed teaching and assessment materials that are included in the framework and supporting materials:

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Betsey Smith, Associate Director for the Research and Curriculum Unit at Mississippi State University

Scott Kolle, Project Manager for the Research and Curriculum Unit at Mississippi State University

Jolanda Young, Educational Technologist for the Research and Curriculum Unit at Mississippi State University

Preface

Secondary career and technical education programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act IV, 2007; and No Child Left Behind Act of 2001).

Pathway Description

Polymer Science is an instructional pathway that introduces an individual to the field of plastics and polymer materials manufacturing. The pathway allows an individual to prepare for employment or continued education in the occupations of plastics and polymer materials manufacturing. The pathway is designed to provide students with hands-on experiences related to the application of polymer science concepts in the workplace. Students will develop academic and technical skills, 21st century skills, and human relations competencies that accompany technical skills for job success and lifelong learning. Students who complete the pathway will be better prepared to enter and succeed in related programs offered by Mississippi community and junior colleges and institutions of higher education.

Industry Certification

Two national certifications are associated with the polymer science industry. They are the **Certified Composites Technician (CCT)** and **the National Certification in Plastics (NCP).**

Assessment

The latest assessment blueprint for the curriculum can be found at http://www.rcu.msstate.edu/Curriculum/CurriculumDownload.aspx

Student Prerequisites

In order for students to experience success in the Polymer Science program, the following prerequisites are recommended:

1. C or Higher in a Physical Science or Biology
   or
2. Instructor Approval

Academic Credit

The latest academic credit information can be found at https://www.rcu.msstate.edu/MDE/PathwaystoSuccess.aspx. Once there, click the "*Counselor Resources*" Tab, then click "*Curriculum Enhancement List.*" Check this site often as it is updated frequently.

Licensure Requirements

The latest teacher licensure information can be found at http://www.mde.k12.ms.us/educator-licensure.

Professional Learning

If you have specific questions about the content of any of training sessions provided, please contact the Research and Curriculum Unit at 662.325.2510.

Course Outlines

Option 1—Four One-Carnegie-Unit Courses
This curriculum consists of four one-credit courses, which should be completed in the following sequence:

1. **Introduction to Polymer Science I – Course Code: 994502**
2. **Introduction to Polymer Science II – Course Code: 994503**
3. **Advanced Topics in Polymer Science – Course Code: 994504**
4. **Careers in Polymer Science – Course Code: 994505**

Course Description: Introduction to Polymer Science I orients the students to the course and lab. During this course, students learn computer applications relevant to polymer science. They are also introduced to chemistry concepts and the structures and properties of polymers.

Course Description: Introduction to Polymer Science II teaches students the processing techniques associated with polymers as well as the methods and benefits of plastics recycling.

Course Description: Advanced Topics in Polymer Science is a comprehensive course that focuses on polymer synthesis, surface coatings, and composite materials.

Course Description: Careers in Polymer Science explores the job opportunities that are available for individuals in this area. The course also teaches job application and workplace skills as well as offers a potential for job shadowing.

Introduction to Polymer Science I (One Carnegie Unit) - Course Code: 994502

Unit	Unit Name	Hours
1	Orientation, Safety, and Information Media	40
2	Recycling	30
3	Introduction to Chemistry	70
Total		140

Introduction to Polymer Science II (One Carnegie Unit) - Course Code: 994503

Unit	Unit Name	Hours
4	Chemistry of Polymers	80
5	Introduction to Polymer Processing	40
Total		120

Advanced Topics in Polymer Science (One Carnegie Unit) - Course Code: 994504

Unit	Unit Name	Hours
6	Polymer Safety and Concepts Review	20
7	Advanced Polymer Processing	40
8	Materials Science	50
Total		110

Careers in Polymer Science (One Carnegie Unit) - Course Code: 994505

Unit	Unit Name	Hours
9	Surface Coatings	30
10	Composite Materials, Processing, and Applications	50
11	School to Work	50
Total		130

Option 2—Two Two-Carnegie-Unit Courses

This curriculum consists of two two-credit courses, which should be completed in the following sequence:

1. **Polymer Science I – Course Code: 994500**

2. **Polymer Science II – Course Code: 994501**

Course Description: Polymer Science I orients the students to the course and lab. During this course, students learn computer applications relevant to polymer science. They are also introduced to chemistry concepts and the structures and properties of polymers. This course also teaches students the processing techniques associated with polymers as well as the methods and benefits of plastics recycling.

Course Description: Polymer Science II is a comprehensive course that focuses on polymer synthesis, surface coatings, and composite materials. This course explores the job opportunities that are available for individuals in this area. It also teaches job application and workplace skills as well as offers a potential for job shadowing.

Polymer Science I (Two Carnegie Units) - Course Code: 994500

Unit	Unit Name	Hours
1	Orientation, Safety, and Information Media	40
2	Recycling	30
3	Introduction to Chemistry	70
4	Chemistry of Polymers	80
5	Introduction to Polymer Processing	40
Total		260

Polymer Science II (Two Carnegie Units) - Course Code: 994501

Unit	Unit Name	Hours
6	Polymer Safety and Concepts Review	20
7	Advanced Polymer Processing	40
8	Materials Science	50
9	Surface Coatings	30
10	Composite Materials, Processing, and Applications	50
11	School to Work	50
Total		240

Polymer Science

Program CIP: 15.0607

Ordering Information

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~~The Research and Curriculum Unit (RCU), located in Starkville, MS, as part of Mississippi State University, was established to foster educational enhancements and innovations. In keeping with the land-grant mission of Mississippi State University, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.~~

Table of Contents

Acknowledgments

The Polymer Science curriculum was presented to the Mississippi Board of Education on March 19, 2010. The following persons were serving on the state board at the time:

Dr. Tom Burnham, State Superintendent
Mr. William Harold Jones, Chair
Mr. Charles McClelland, Vice Chair
Ms. Kami Bumgarner
Mr. Howell "Hal" N. Gage
Dr. O. Wayne Gann
Mr. Claude Hartley
Ms. Martha "Jackie" Murphy
Ms. Rosetta Richards
Dr. Sue Matheson

Mike Mulvihill, Interim Associate State Superintendent of Education for the Office of Vocational Education and Workforce Development at the Mississippi Department of Education, assembled an oversight committee to provide input throughout the development of the *Polymer Science Curriculum Framework and Supporting Materials.* Members of this task force were as follows:

Dr. Kay Berry, Simpson County School District
Dr. Sam Bounds, Mississippi Association of School Superintendents
Kevin F. Gilbert, Mississippi Association of Educators
David Campbell, Mississippi Association of Middle Level Educators
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Mary Hardy, Mississippi PTA
Anna Hurt, Mississippi Association of School Administrators
Jay Moon, Mississippi Manufacturers Association
Dr. Dean Norman, Center for Advanced Vehicular Systems Extension
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Pete Walley, Institutions of Higher Learning
Clarence Ward, Boys and Girls Clubs of the Gulf Coast
Debra West, State Board for Community and Junior Colleges

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Tom Bryant, Engineering Associates, Inc.
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Sharon Hudson, Mississippi Department of Education
Carol Ingram, Lamar County Public Schools
Jeff Jones, Mississippi Gulf Coast Community College
Mattie Jones, Pontotoc Career Center
Jean Massey, Rankin County Schools
Jim McRae, Clearspan
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Myra Pannell, Research and Curriculum Unit
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Cindy West, Hinds Community College
Jennifer Wilson, Rankin County Public Schools

Also, a special thanks is extended to the teachers who contributed teaching and assessment materials that are included in the framework and supporting materials. Members who contributed are as follows:

James Brownlow, Hattiesburg High School, Hattiesburg, MS
Krystin Breland, Petal High School, Petal, MS
Lisa White, Carl Loftin Career and Technology Center, Columbia, MS
Leahann Peavey, Brookhaven High School, Brookhaven, MS
Mark Walsh, Moss Point High School, Moss Point, MS
Nicole McWright, Moss Point High School, Moss Point, MS
Dave Nicholas, Simpson County Technical Center, Mendenhall, MS
Ty Posey, University of Southern Mississippi, Hattiesburg, MS

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Bill McGrew, Program Coordinator, Office of Vocational Education and Workforce Development, Mississippi Department of Education, Jackson, MS

Finally, standards in the *Polymer Science Curriculum Framework and Supporting Materials* are based on the following:

Society of the Plastics Industry Standards
Founded in 1937, SPI is the plastics industry trade association representing the third largest manufacturing industry in the United States. SPI's member companies represent

the entire plastics industry supply chain, including processors, machinery and equipment manufacturers, and raw materials suppliers. http://www.plasticsindustry.org

Polymer Standards for the State of Mississippi

From the study, *Analysis of the Micro Economic Environment and Labor Needs for Development of the Plastics and Polymers Industry Cluster in Mississippi* prepared for the Mississippi Development Authority Mississippi Technology Alliance with the University of Southern Mississippi, Center for Community and Economic Development, Workforce Training and Development, March 2002

Applied Academic Credit Benchmarks

Mississippi Department of Education 2010 Mississippi Science Framework Revised

21st Century Skills and Information and Communication Technologies Literacy Standards

In defining 21st century learning, the Partnership for 21st Century Skills has embraced five content and skill areas that represent the essential knowledge for the 21st century: global awareness; civic engagement; financial, economic, and business literacy; learning skills that encompass problem-solving, critical thinking, and self-directional skills; and Information and Communication Technology (ICT) literacy.

National Educational Technology Standards for Students

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ACT College Readiness Standards

The College Readiness Standards are sets of statements intended to help students understand what is expected of them in preparation for the ACT. These standards are integrated into teaching and assessment strategies throughout the curriculum framework.

~~Preface~~

~~Secondary vocational–technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.~~

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Polymer Science Executive Summary

Pathway Description

Polymer Science is an instructional pathway that introduces an individual to the field of plastics and polymer materials manufacturing. The pathway allows an individual to prepare for employment or continued education in the occupations of plastics and polymer materials manufacturing. The pathway is designed to provide students with hands-on experiences related to the application of polymer science concepts in the workplace. Students will develop academic and technical skills, 21st century skills, and human relations competencies that accompany technical skills for job success and lifelong learning. Students who complete the pathway will be better prepared to enter and succeed in related programs offered by Mississippi community and junior colleges and institutions of higher education.

Industry Certification

Two national certifications are associated with the polymer science industry. They are the **Certified Composites Technician (CCT)** and **the National Certification in Plastics (NCP).**

Assessment

Students will be assessed using the Polymer Science MS-CPAS2 test. The MS-CPAS2 blueprint can be found at http://info.rcu.msstate.edu/services/curriculum.asp. If there are questions regarding assessment of this program, please contact the STEM instructional design specialist at the Research and Curriculum Unit at 662.325.2510.

Student Prerequisites

In order for students to experience success in the Polymer Science program, the following prerequisites are recommended:

1. C or Higher in a Physical Science or Biology

   or

2. Instructor Approval

Applied Academic Credit

The Polymer Science curriculum is aligned and correlated with the competencies in the Organic Chemistry course found in the 2010 Mississippi Science Framework. The student must complete the 2-course sequence (4 Carnegie units) of Polymer Science.

Licensure Requirements

The 989 licensure endorsement is needed to teach the Polymer Science pathway. The requirements for the 989 licensure endorsement are listed below:

1. Applicant must have earned a 4-year degree (bachelor's degree) or higher from an accredited institution of higher education. The degree must be in polymer science, chemistry, or an appropriate field of science and must be approved by the MDE program coordinator.
2. Applicant must enroll immediately in the Vocational Instructor Preparation (VIP) or the *Redesign* Education Program (REP).
3. Applicant must complete the individualized Professional Development Plan (PDP) requirements of the VIP or REP prior to the expiration date of the 3-year vocational license.
4. Applicant must successfully complete an MDE-approved computer literacy certification exam.

5. Applicant must successfully complete certification for an online learning workshop, module, or course that is approved by the MDE.
6. Applicant must successfully complete a Polymer Science certification workshop, module, or course that is approved by the MDE.

Note: If an applicant meets all requirements listed above, that applicant will be issued a 989 endorsement—a 5-year license. If the applicant does not meet all requirements, the applicant may be issued a 3-year endorsement (license), and all requirements must be satisfied prior to the ending date of that license.

Exception: LEAs converting to this pathway from existing programs in Plastics and Polymer Science Applications (with teachers currently licensed and endorsed #379 Plastics and Polymer Science Applications) may continue to employ those teachers and seek 989 endorsement for them although they do not meet the above stated requirement for a 4-year degree in certain major fields of study. These teachers must satisfy all other requirements stated above. All other teachers must meet the requirements for this endorsement.

Professional Learning

The professional learning itinerary for the middle school or individual pathways can be found at http://redesign.rcu.msstate.edu. If you have specific questions about the content of each training session provided, please contact the Research and Curriculum Unit at 662.325.2510, and ask for the Professional Learning Specialist.

Course Outlines

This curriculum framework is divided into four one-Carnegie-unit courses as outlined below. The first two courses are comprised of units from Polymer Science Year 1. The last two courses are comprised of units from Polymer Science Year 2.

Option 1 – Four One-Carnegie-Unit Courses

Course Description: Introduction to Polymer Science I orients the students to the course and lab. During this course, students learn computer applications relevant to polymer science. They are also introduced to chemistry concepts and the structures and properties of polymers.

Course Description: Introduction to Polymer Science II teaches students the processing techniques associated with polymers as well as the methods and benefits of plastics recycling.

Course Description: Advanced Topics in Polymer Science is a comprehensive course that focuses on polymer synthesis, surface coatings, and composite materials.

Course Description: Careers in Polymer Science explores the job opportunities that are available for individuals in this area. The course also teaches job application and workplace skills as well as offers a potential for job shadowing.

Introduction to Polymer Science I (One Carnegie Unit) - Course Code: 994502

Unit		Title	Hours
1		Orientation and Safety	40
2		Information, Media, and Computer Applications	40
3		Introduction to Chemistry	30
4		Structure and Properties of Polymers	30
			140

Introduction to Polymer Science II (One Carnegie Unit) - Course Code: 994503

Unit		Title	Hours
5		Polymer Processing	60
6		Recycling	60
			120

Advanced Topics in Polymer Science (One Carnegie Unit) - Course Code: 994504

Unit		Title	Hours
7		Orientation and Safety Review	10
8		Polymer Synthesis	60
9		Surface Coatings	20
10		Composite Materials, Processing, and Applications	30

			120

Careers in Polymer Science (One Carnegie Unit) - Course Code: 994505

Unit		Title	Hours
11		School to Work	110
			110

Option 2 – Two Two-Carnegie-Unit Courses

Course Description: Polymer Science I orients the students to the course and lab. During this course, students learn computer applications relevant to polymer science. They are also introduced to chemistry concepts and the structures and properties of polymers. This course also teaches students the processing techniques associated with polymers as well as the methods and benefits of plastics recycling.

Course Description: Polymer Science II is a comprehensive course that focuses on polymer synthesis, surface coatings, and composite materials. This course explores the job opportunities that are available for individuals in this area. It also teaches job application and workplace skills as well as offers a potential for job shadowing.

Polymer Science I (Two Carnegie Units) - Course Code: 994500

Unit		Title	Hours
1		Orientation and Safety	40
2		Information, Media, and Computer Applications	40
3		Introduction to Chemistry	30
4		Structure and Properties of Polymers	30
5		Polymer Processing	60
6		Recycling	60
			260

Polymer Science II (Two Carnegie Units) - Course Code: 994501

Unit		Title	Hours
7		Orientation and Safety Review	10
8		Polymer Synthesis	60
9		Surface Coatings	20
10		Composite Materials, Processing, and Applications	30
11		School to Work	110
			230