Materials Science and Engineering

UNDERGRADUATE PROGRAM HANDBOOK 2025-2026

UPDATED SEPTEMBER 2025

Contents

Materials Science and Engineering Introduction	3
Materials Science and Engineering Mission	4
Accreditation	4
The Program Educational Objectives of the Materials Science and Engineering Program	4
Student Outcomes	4
Materials Science and Engineering Undergraduate Program	5
Technical Electives	6
General Education & Bachelor Degree Requirements	6
Senior Design Project	7
Required Courses	7
Group Component	7
Design Component	8
Grading	8
Honors	8
Honors Thesis	8
Engineering Entrepreneurship Certificate	9
Undergraduate Other Information & Policies	9
Admissions	9
Transfer Students	9
Freshman Direct Admit	10
Graduation	10
Undergraduate Policies	10
Grading	10
Adding, Dropping and Withdrawal Procedures	11
Repeating Courses	11
Major Declassification	11
Leave of Absence	12
Appeals of Procedures	12
Americans with Disabilities Act	12
Academic Standings	12
Resources	13
University Resources	13

Materials Science and Engineering Introduction

Materials Science and Engineering (MSE) intertwine numerous disciplines, including chemistry, physics and engineering. It is the one discipline within the College of Engineering that still gives the students the opportunity to study science while earning an engineering degree. Materials Scientists apply the principles of physics and chemistry to design and development of new materials for engineering applications. This application is a critical aspect of engineering, as virtually all technological advances are limited by the available materials. As a result of this challenge, materials scientists and engineers are engaged in exploring the numerous ways that materials can enrich everyday lives. Without this effort to discover and develop new materials, our world of computers, wireless phones, biomedical implants, aircrafts, autos, and compact disks could not exist.

Materials science and engineering is a broad field that encompasses many different classes of materials. These materials include polymers, ceramics, electronic materials, composites, biomaterials, nuclear materials and nanomaterials. The common thread between these materials is the need to improve their processing and properties and continue to develop new materials. Continued research is critical for the advancement and improvement of materials that underlie technologies used to develop energy sources, protect the environment, preserve the national infrastructure, cure diseases, and improve communication.

An undergraduate degree in materials science and engineering can also be a springboard to other careers. For example, an engineering degree coupled with a Master's in Business Administration (MBA) provides an avenue into a career in management or the background for entrepreneurial efforts. Many graduates also choose to pursue a career in medicine or law after obtaining a B.S. in Materials Science and Engineering.

The Department of Materials Science and Engineering prides itself in being a student friendly department. As a modest sized department, class sizes are small, allowing significant interaction with faculty. Many of our faculty have won teaching and research awards. While research is thought to detract from teaching, employing undergraduates to assist in conducting research allows undergraduate students a unique opportunity. This increases one-on-one interactions with faculty and enhances the overall educational experience.

The administrative staff is committed to serving the students. They are an invaluable source of information and students are highly encouraged to make themselves known to the staff. Students are required to visit with the Academic Advisor yearly to plan their next year course of study. It is important for transfer students to make an appointment with the Academic Advisor to make sure that the University of Utah transferred their credits and to know what credits will transfer to the Materials Science and Engineering program.

Additionally, here are some helpful suggestions to heighten your educational experience and to help you be more successful in your studies:

- ✓ Manage your time wisely
- ✓ Utilize university resources such as tutors, resource centers, etc.
- ✓ Utilize your professors by asking questions
- ✓ Make out-of-class contact within the MSE Department
- ✓ Follow the Program of Study

Materials Science and Engineering Mission

The mission of the Materials Science and Engineering program at the University of Utah is to create an inclusive environment through teaching, research, and service that (i) allows training of materials science and engineering undergraduate and graduate students with the broad technical knowledge, critical thinking abilities, communication skills, social consciousness, and integrity necessary to become outstanding engineers and scientists in industry and academia, (ii) facilitates generation of new knowledge, and (iii) provides supporting service through consulting or other avenues to industry, government and the general public. The department strives to produce graduates with the necessary breadth of technical skills in separation and materials processing, synthesis, characterization, product development, research and development, and manufacturing, that will make them strong competitors in the job market created by the materials, manufacturing, and consumer product industries. The program offers exceptional opportunities for students to undertake research in a wide range of fields at a level that extends the frontiers of knowledge.

Accreditation

The Materials Science and Engineering Program is accredited by The Engineering Accreditation Commission of ABET, Accreditation Board for Engineering and Technology (www.abet.org), 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; Telephone: (410) 347-7700.

The Program Educational Objectives of the Materials Science and Engineering Program

For the B.S. degree in Materials Science and Engineering, the Program Educational Objectives are:

- 1. Graduates will succeed in materials science and engineering and related professions.
- 2. Graduates will be successful in graduate programs in materials science and engineering or related fields.
- 3. Graduates will be capable of advancing in their chosen careers and stay up to date on technological developments.
- 4. Graduates will be capable of engaging in research and development and advanced study in Materials Science and Engineering and related fields.
- 5. Graduates will be aware of global issues and educated to make ethical and informed decisions.

Student Outcomes

The following student outcomes of the curriculum are assessed in order to meet Materials Science and Engineering B.S. Degree Program Educational Objectives

- 1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- 2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- 3. An ability to communicate effectively with a range of audiences.

- 4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts.
- 5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- 6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- 7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
- 8. An ability to understand structure, properties, processing, and performance relationships.

Materials Science and Engineering Undergraduate Program

Materials Science and Engineering is an integrated discipline of chemistry, physics and engineering. This is reflected in our Program of Study. The student receives a foundation of basic chemistry, physics and engineering coursework during their first two years. These courses are then woven into a Materials Science and Engineering framework.

The detailed Program of Study is shown below. This must be used as a guideline to complete the degree requirements. Most courses have prerequisites that must be completed first. Prerequisites can be found in the current University of Utah General Catalog which can be found online at: http://catalog.utah.edu/. Also, many courses and all MSE courses are only offered one semester per year, please plan carefully. The Program of Study is a roadmap to be used in planning your degree. It is necessary that students follow the Program of Study as closely as possible; any deviation must be arranged in advance with the Academic Advisor. Taking courses out of sequence may result in a conflict, particularly if a student is planning to continue in the combined BS/MS program.

Major Required Courses

Students admitted to major status are required to complete the following Materials Science and Engineering courses with a "C" grade or better and a minimum 2.3 GPA. Courses required for this major may only be taken twice.

MATH

- MATH 1310 Engineering Calculus I (4 credits)
- MATH 1320 Engineering Calculus II (4 credits)

OR

- MATH 1210 Calculus I
- MATH 1220 Calculus II
- MATH 2210 Calculus III

AND

- MATH 2250 Differential Equations and Linear Algebra (4 credits)
- MATH 3150 Partial Differential Equations for Engineers (4 credits)

CHEMISTRY

- CHEM 1210 General Chemistry I (4 credits)
- CHEM 1215 General Chemistry Lab I (1 credit)
- CHEM 1220 General Chemistry II (4 credits)
- CHEM 1225 General Chemistry Lab II (1 credit)
- CHEM 2310 Organic Chemistry I (4 credits)

PHYSICS

- PHYS 2210- Physics for Scientists and Engineers I (4 credits)
- PHYS 2220- Physics for Scientists and Engineers II (4 credits)

ENGINEERING

- ME EN 2010 Statics (3 credits) OR MET E 2300 Strengths of Materials (2 credits)
- MSE 2010 Introduction to Materials Science & Engineering (4 credits)
- MSE 3061 Transport Phenomena in Materials Science & Engineering (3 credits)
- MSE 2001 Python (OR COMP 1010 OR CS 1400)
- MSE 3010 Materials Processing Laboratory (3 credits)
- MSE 3011 Structural Analysis of Materials (4 credits)
- MSE 3032 Introduction to Thermodynamics (4 credits) OR MET E 3630 Metallurgical Thermodynamics II
- MSE 3210 Electronic Properties of Solids (3 credits)
- MSE 3310 Introduction to Ceramics (3 credits)
- MSE 3410 Introduction to Polymers (3 credits)
- MSE 5034 Kinetics of Solid-State Processes (3 credits)
- MSE 5090 Professional Communications for Materials Science and Engineering (3 credits)
- MSE 5098 Senior Design (4 credits)
- MET-E 5450 Mechanical Behavior of Metals (3 credits)
- Section 1 Technical Electives (5 credits) [Within MSE & METE]
- Section 2 Technical Elective (3 credits) [Outside of MSE & METE]

Technical Electives

Students are required to complete four 5000 level or above courses for the technical elective requirement. Please select two courses from Section 1 and one course from Section 2. All courses are 2 to 4 credit hours, and must be passed with a "C" grade or better.

For an updated list of MSE Technical Electives, visit https://mse.utah.edu/undergraduate/bs-technical-electives/

General Education & Bachelor Degree Requirements

Students must fulfill the University of Utah's General Education and Bachelor Degree requirements in addition to the MSE degree requirements to graduate.

GE website https://ugs.utah.edu/general-education/requirements/index.php

General Education Requirements:

General Education (GE) Core Requirements:

- Lower Division Writing (3) (WR1) 1 course
- Lower Division Writing (3) (WR2) 1 course
- American Institutions (3) (AI) 1 course
- Quantitative Literacy (3) (QL) 1 course

General Education (GE) Breadth Requirements

- Fine Arts (FF) (3) 1 course
- Humanities (HF) (3) 1 course
- Life Science (LS) (3) 1 course
- Physical Science (PS) (3) 1 course
- Social/Behavioral Science (BF) (3) 1 course

Bachelor's Degree Courses

- Communication & Writing (CW) (3) 1 course
- Diversity (DV) (3) 1 course
- International (IR) (3) 1 course
- Quantitative Intensive (QI) (3) 1 course

Senior Design Project

The senior design project is a capstone project that prepares the student for engineering design practice. It provides an avenue to determine if the student has an integrated understanding of the scientific and engineering principles

Required Courses

MSE 5090 Case Studies is the pre-requisite to MSE 5098 Senior Design and MSE 5099 Senior Thesis. Students must take MSE 5090 Spring Semester of their Junior Year. NO EXCEPTIONS. Students not prepared for senior level courses will not be permitted to take MSE 5090. The required senior design project consists of three courses taken during the senior year:

- <u>Professional Communications for Materials Science and Engineering</u>, Spring Semester 3
 credits Junior Year
- Senior Design (MSE 5098) Fall Semester 4.0 credits Senior Year

Group Component

Senior design projects are group projects with the size of the team varying based on class size. If the student is a BS/MS student or an honors student, they should be a team leader for their respective groups. The Honors Students would need to complete an individual paper per the Honors College Requirement.

The projects will be identified by the Senior Design/Thesis Advisor who has previously obtained from all participating Materials Science and Engineering faculty, possible projects. The students will rank their interest in each project presented by the faculty based on the interest of the student (ceramics, composites, computation, electronic materials and polymers). The Senior Advisor will create the teams based on the input from the students.

Design Component

Senior design projects must be designing projects and not research projects. For more information on this, please review the Senior Design Handbook.

Grading

Grading will be done by a committee, with input from the instructor(s) for MSE 5098/5099 and the Faculty advisor for the teams. This will be based on the participation in both MSE 5098 and MSE 5099. Both the faculty advisors and the instructor(s) will submit a report on the participation of each student on each team to the academic advisor to be used in the meeting to discuss the grades. Grades for both MSE 5098 and MSE 5099 will be assigned for each student after the meeting.

Grades will not be given for MSE 5098 and MSE 5099 until the senior design and thesis project has been completed and signed off by the faculty advisor, the instructor(s), and the department chair.

The completed senior design project is due the last day of classes of the Spring Semester the student is enrolled in MSE 5099, regardless of if the student has classes to take Summer or Fall Semester. The Senior Thesis must be signed by the faculty project advisor and ready for submission to the instructor for signature before the due date. NO EXCEPTIONS.

Honors

To be an Honors Student in Materials Science and Engineering, students must have been admitted to the University of Utah Honors College at admissions time. Students who are honors students need to work with the Academic Advisor to make sure they are taking the appropriate courses for their Honors Degree. More information on the Honors College and the honor degree requirements can be found at https://honors.utah.edu/.

Honors Thesis

Honors student must complete an Honors Thesis. Honors students are required to submit a completed Honors Thesis Proposal Form to the Honors College during the Junior Year. The proposal form must be signed by the Department Honors Advisor and the Senior Thesis Advisor.

Honors students are required to present their thesis work at the annual Undergraduate Research Symposium at the University of Utah, which is in early April. The Honors College will contact the student about deadlines and requirements.

Honors students are also required to publish their thesis abstract in the University of Utah Undergraduate Research Abstract Journal. This is due mid-March of the senior year. The Honors College will contact the student for formatting guidelines and deadlines.

Honors students are strongly encouraged to publish in other peer reviewed journals based on their research interest.

The Honors Thesis is due to The Honors College on the last day of classes, which is the department deadline for all Senior Design Projects. The honors thesis must be signed by the Senior Thesis Advisor, the Departmental Honors Advisor, Senior Thesis Advisor, and the Department Chair before it is submitted to The Honors College for the Dean of The Honors College signature. Check with The Honors

College for number of copies required. Materials Science and Engineering will accept The Honors College formatting of the thesis for submission to complete the department requirements.

Engineering Entrepreneurship Certificate

In partnership with the David Eccles School of Business, the Engineering Entrepreneurship Certificate offers engineering students the opportunity for hands-on innovation experience as well as a strong foundation in the business aspects of technology. The program is intended for students who want to start their own company as well as for those interested in the complexities of the dynamic business world in which we live. Our aim is to provide the educational background to thrive in small and large business environments, convey technical information in business terms and understand business viability of engineering solutions. All engineering students interested in understanding the complexities of the dynamic business world in which we live are invited to apply. For more information, visit https://entrepreneurship.coe.utah.edu/.

Undergraduate Other Information & Policies

Admissions

It is the policy of the Department of Materials Science and Engineering that every student who aspires to become an engineer should have an opportunity to obtain that goal. Students admitted to the University of Utah may designate Materials Science and Engineering as a major and begin a program under the Pre-Materials Science and Engineering classification.

The first step for prospective students is to apply for admissions to the University of Utah, for more information visit http://admissions.utah.edu/.

Any student may be admitted to pre-major status in Materials Science and Engineering (MSE) by requesting Pre-MSE on their application for admission or applying through the MSE Academic Advisor. Students must meet with the MSE Academic Advisor to gain major status. Major status requires students to complete the prerequisite courses listed above with a "C" grade or better and a minimum 2.3 GPA. Courses required for this major may only be taken twice.

Transfer Students

Transfer students are those who have already attended any other universities or colleges. The applications process for transfer students is different than for freshman. For information on the admission process, application requirements, deadlines, and how to transfer credit, please visit

http://admissions.utah.edu/apply/undergraduate/transfer/.

The College of Engineering offers many scholarships for transfer students.

Please visit http://www.coe.utah.edu/scholarships.

Students with transfer credit must meet with an Academic Advisor as soon as they are admitted to the University of Utah and have declared Materials Science & Engineering as their major. In-State Transfer Credit is evaluated using the State Articulation Guide. Out-of-State Transfer Credit is evaluated on a case-by-case basis using course descriptions from the transfer school. Transfer students are required to

take PHIL 3500, 3520, or 3530, regardless of their completing the General Education requirements at their transfer institution.

Freshman Direct Admit

Direct admission to the College of Engineering is competitive, and requirements are designed to identify students who are prepared for the rigors of engineering study. Factors for direct admission include math preparation (usually students should be able to take Calculus 1 or higher their first semester) and strong college prep curriculum (emphasis on math and science courses). Students may (but are not required to) submit ACT/SAT scores, which serve as another way for students to be evaluated for direct admission.

Students accepted to the College with direct admission will receive an extra insert in their U admission packet. In order to accept direct admission, students will need to confirm their intent to enroll at the University of Utah in the College of Engineering and pay the enrollment deposit by the May 1 deadline at admissions.utah.edu/deposit.

Once students accept admission to both the U and the College of Engineering, their information will be sent to their intended major's department for consideration. Some departments will accept direct admission students immediately. Others will accept direct admission students once they have completed pre-requisite courses. Either way, all direct admission students will be taking beginning engineering courses toward their majors.

For more information, visit https://www.coe.utah.edu/students/future/admissions/

Graduation

The following process is recommended to help students prepare for graduation:

- During the semester before your graduation date, students should generate a degree audit on CIS in My Degree Dashboard. For more information on how to generate an audit, visit http://mydegreedashboard.utah. edu/.
- If students have questions or issues surrounding graduation, they should make an appointment with the MSE Academic Advisor. It is important that you communicate with the Academic Advisor about your intended graduation date and progress.

In order to graduate, students must meet all of the University of Utah requirements as well as the department requirements for graduation.

For graduation deadlines and how to apply visit: http://registrar.utah.edu/graduation/index.php/.

Students can also find information on the Commencement Ceremony at:

http://commencement.utah.edu/index.php.

Undergraduate Policies

Grading

Materials Science & Engineering Undergraduates are required to take all MSE courses and receive a grade of "C" or better in order to advance to higher level MSE courses. If a student does not receive a "C" or better in a MSE course they will be required to retake the course. Failure to receive a "C" or better on the second attempt will result in dismissal from the program.

A cumulative grade point average of 2.3 or higher must be maintained for all courses completed towards a degree in Materials Science and Engineering. Students who fall below the GPA of 2.3 will be put on probation. Students on probation must raise their cumulative GPA above a 2.3 within 12 months or they will be dropped from the program.

Adding, Dropping and Withdrawal Procedures

Students should meet with both the MSE Academic Advisor and a Financial Aid Advisor before dropping and withdrawing from a course. Dropping and withdrawing from a course can affect a student's financial aid.

Adding Classes - All classes must be added within two weeks of the beginning of the semester. Adding classes after the deadline is not permitted in the College of Engineering and requires a petition letter.

Dropping Classes – A drop implies that the student will not be held financially responsible and a "W" will not be listed on the transcript. Student may drop any class without penalty or permission during the first ten calendar days of the term.

Withdrawing from Classes – means that a "W" will appear on the student's transcript and tuition will be charged. Withdrawal from Full Term Length –Beginning the eleventh calendar day and continuing through the midpoint of the term, students may withdraw from a class or the University without instructor/department permission. After midpoint of the term, students may petition the deadline for withdrawal if they have a nonacademic emergency. For more information about the petition process, please contact your Academic Advisor.

Check the <u>academic calendar</u> for specific add, drop, and withdrawal dates.

Repeating Courses

When a College of Engineering class is taken more than once, only the grade for the second attempt is counted. Grades of W, I, or V on the student's record count as having taken the class. The MSE Department enforce these guidelines for other courses as well (e.g., math, physics biology, chemistry). Attempts of courses taken at transfer institutions count as one attempt. This means a student may take the course only one time at the University of Utah. Courses taken at the University of Utah may not be taken a second time at another institution. If a second attempt is needed, it must be at the University of Utah. Please work with your Academic Advisor to determine the value of repeating courses. Students should note that anyone who takes a required class twice and does not have a satisfactory grade the second time may not be able to graduate. It is the responsibility of the student to work with the department of their major to determine how this policy applies in extenuating circumstances.

Students must meet with an Academic Advisor and complete the MSE Course Repeat Petition form, available at https://mse.utah.edu/wp-content/uploads/sites/34/2021/07/repeating-courses.pdf

Major Declassification

It is the goal of the Materials Science and Engineering Department to successfully graduate all Materials Science and Engineering students. However, any student who does not perform satisfactorily may be dropped from the program. "Satisfactory performance" must be evaluated individually but generally consists of meeting the standards of professional and ethical conduct that are expected of engineers (and hence engineering students), and maintaining satisfactory academic progress. While it is impossible to give an exhaustive list of actions that could cause us to revoke Major Status, examples include:

- Cheating or plagiarizing
- Abuse of faculty or teaching assistants
- Other serious violation of the student behavior code
- Failing to pass major required courses within the boundaries of the repeat policy
- Allowing your cumulative GPA to drop below a 2.3

Leave of Absence

A Leave of Absence allows degree-seeking undergraduate students who have registered for and completed university credit classes to request an extension of their enrollment eligibility for a maximum period of seven consecutive semesters (including summers). Requests are reviewed on a case-by-case basis and may be granted for the following reasons: illness (personal or familial), military service, humanitarian or religious service, or participation in a University of Utah sponsored program. To apply for a leave of absence and for more information, visit https://registrar.utah.edu/handbook/leave.php

Appeals of Procedures

If a student believes that an academic action is arbitrary or capricious he/she should discuss the action with the involved faculty member and attempt to resolve. If unable to resolve, the student may appeal the action in accordance with the following procedure.

- 1. Appeal to the Department Chair (in writing) within 40 working days; chairs must notify student of a decision with 15 days. If the faculty member or student disagrees with decision then,
- 2. Appeal to Academic Committee, see II Section D, Code of Student Rights and Responsibilities for details on Academic Appeal Committee hearings.

Americans with Disabilities Act

The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in classes, reasonable prior notice needs to be given to the instructor and to the Center for Disability and Access.

Academic Standings

Academic Warning

A student whose cumulative GPA falls below 2.0 from good standing shall be placed on academic warning and have a hold placed on their account preventing course registration. To clear this hold, the student must complete the academic success workshop, which includes a workbook and a quiz. Detailed instructions on how to complete the workshop are emailed to the student's university email account after grades are posted.

Second Warning

A student who goes back to academic warning and who has already completed the academic success workshop must now meet with an Academic Advising Center advisor. In order to remove the registration hold, please contact the Academic Advising Center to schedule a second warning appointment with an advisor.

Please schedule an appointment by calling 801-581-8146

Academic Probation

A student already on academic warning whose cumulative GPA and most recent term GPA are below 2.0 will be placed on academic probation. A registration hold is placed on the student's record until they meet with their department advisor AND an Academic Advising Center advisor.

For more information on Academic Standings and how to remove an Academic Warning, visit https://advising.utah.edu

Resources

University Resources

Our students' success and well-being are paramount in providing a world-class education. Take advantage of the numerous resources and services created to help students of all kinds prosper during their time at the U.

- Academic Advising Center https://advising.utah.edu
- Office of Undergraduate Research https://our.utah.edu/urop/
- <u>International Center</u> https://internationalcenter.utah.edu
- Learning Abroad https://leaningabroad.utah.edu
- <u>Counseling Center</u> https://counselingcenter.utah.edu
- Dean of Students https://deanofstudents.utah.edu
- <u>Disability Services</u> https://disability.utah.edu
- Equal Opportunity & Affirmative Action https://oeo.utah.edu
- <u>LGBT Resource Center</u> https://lgbt.utah.edu
- Student Wellness https://wellness.utah.edu
- <u>Veterans Support Center</u> https://veteranscenter.utah.edu
- <u>Women's Resource Center</u> https://womenscenter.utah.edu
- Leave of Absence https://registrar.utah.edu/handbooks/leave.php

For additional student resources, see https://www.utah.edu/students/services.php.

Safety and Wellness

Your safety is our top priority. In an emergency, dial 911 or seek a nearby emergency phone (throughout campus). Report any crimes or suspicious people to 801-585-COPS; this number will get you to a dispatch officer at the University of Utah Department of Public Safety (DPS; dps.utah.edu). If at any time, you would like to be escorted by a security officer to or from areas on campus, DPS will help — just give a call.

The University of Utah seeks to provide a safe and healthy experience for students, employees, and others who make use of campus facilities. In support of this goal, the University has established confidential resources and support services to assist students who may have been affected by harassment, abusive relationships, or sexual misconduct. A detailed listing of University Resources for campus safety can be found at https://registrar.utah.edu/handbook/campussafety.php

Your well-being is key to your personal safety. If you are in crisis, call 801-587-3000; help is close.

The university has additional excellent resources to promote emotional and physical wellness, including the Counseling Center (https://counselingcenter.utah.edu), the Wellness Center

(https://wellness.utah.edu), and the Women's Resource Center (https://womenscenter.utah.edu). Counselors and advocates in these centers can help guide you to other resources to address a range of issues, including substance abuse and addiction.