

MICROBIOLOGY (MICRO)

Any experimental courses offered by MICRO can be found at:

registrar.iastate.edu/faculty-staff/courses/explisting/ (<http://www.registrar.iastate.edu/faculty-staff/courses/explisting/>)

Courses primarily for undergraduates:

MICRO 101: Microbial World

(3-0) Cr. 3. F.

Prereq: High school biology or equivalent

Introduction to the importance of viruses, bacteria, fungi, archaea and parasites both to humans and to the biosphere. Topics include past and present microbial impact on humans and society, ecology and diversity of microbes, biotechnology and microbial impact on the biosphere.

MICRO 110: Professional and Educational Preparation in Microbiology

(1-0) Cr. 1. F.

An introduction to curriculum and research opportunities in microbiology at Iowa State. Topics include: easing the transition to life as a university student, development of specific goals, strengthening interpersonal communication, professional portfolio creation and resume building. Offered on a satisfactory-fail basis only.

MICRO 115: Phage Discovery Lab

(0-4) Cr. 2. F.

An exploratory laboratory where students will purify phage from soil, visualize phage using electron microscopy and isolate genomic material for nucleic acid sequencing.

MICRO 116: Phage Genome Annotation Lab

(0-4) Cr. 2. S.

Prereq: Recommended: MICRO 115

An experiential microbiology laboratory where students learn to annotate and submit a complete phage genome.

MICRO 201: Introduction to Microbiology

(2-0) Cr. 2. F.S.

Prereq: One semester of college-level biology

Selected topics in microbiology with emphasis on the relationship of microorganisms to human and animal health, agricultural technology, and the environment. With written petition to the chair of the supervisory committee, students who obtain a grade of B or better may substitute 201 for Micro 302 in advanced courses.

MICRO 201L: Introductory Microbiology Laboratory

(0-3) Cr. 1. F.S.

Prereq: Credit or enrollment in MICRO 201 or MICRO 302

Basic microbiology laboratory techniques for non-microbiology majors. Credit for either Micro 201L or 302L, but not both, may be applied toward graduation.

MICRO 302: Biology of Microorganisms

(3-0) Cr. 3. F.S.SS.

Prereq: BIOL 211, credit or enrollment in BIOL 212; 1 semester of chemistry
Basic cell biology, physiology, metabolism, genetics and ecology of microorganisms, with an emphasis on prokaryotes and viruses, as well as the roles of microorganisms in the environment, disease, agriculture, and industry.

MICRO 302L: Microbiology Laboratory

(0-3) Cr. 1. F.S.

Prereq: Credit or enrollment in MICRO 302

Basic microbiology laboratory techniques for majors in microbiology, biological sciences and related fields. Credit for either Micro 201L or 302L, but not both, may be applied toward graduation.

MICRO 310: Medical Microbiology

(3-0) Cr. 3. F.

Prereq: MICRO 302 (or MICRO 201 if a B or better was obtained)

Study of infection by bacterial and viral pathogenic agents of humans with an overview of immune responses in controlling disease.

MICRO 310L: Medical Microbiology Laboratory

(0-3) Cr. 1. F.

Prereq: MICRO 201 or MICRO 302; MICRO 201L or MICRO 302L; credit or enrollment in MICRO 310

Microbiological tools and techniques to isolate, identify, and characterize medically significant microorganisms in relation to human diseases. Emphasis on the virulence factors of pathogenic organisms as compared to the normal flora.

MICRO 320: Molecular and Cellular Bacteriology

(4-0) Cr. 4. S.

Prereq: MICRO 302, BIOL 313, credit or enrollment in CHEM 332

A systems perspective of bacterial growth, survival, and cellular differentiation by integrating physiological and genetic principles. Emphasis is on prokaryotes although unicellular eukaryotes are also discussed. Topics include the structure, function, and assembly of cell components, molecular and genomic techniques, bioenergetics and metabolism, regulation of gene expression, genetic adaptation, stress tolerance, biofilms, and cell-cell interactions and communications.

MICRO 353: Introductory Parasitology

(Cross-listed with BIOL, V PTH). (3-0) Cr. 3. S.

Prereq: BIOL 212

Biology and host-parasite relationships of major groups of animal parasites, and techniques of diagnosing and studying parasites.

MICRO 360: Global Health

(Cross-listed with GLOBE, V MPM). (3-0) Cr. 3. F.

Prereq: BIOL 211

Explores human health across the world with particular emphasis on low- and lower-middle-income countries. Attention is given to the interconnectedness of health determinants, problems, and solutions found in global health, including the role of animals and the environment. Broad in scope, highlighting different cultures and the historical foundations of global health. Topics include colonialism, poverty, emerging diseases, climate change, biodiversity, one health, maternal and child health, HIV, malaria, urbanization, noncommunicable diseases and more. Current events will be a feature of all class meetings.

MICRO 374: Insects and Our Health

(Cross-listed with ENT). (3-0) Cr. 3. S.

Prereq: 3 credits in biological sciences

Identification, biology, and significance of insects and arthropods that affect the health of humans and animals, particularly those that are vectors of disease.

Meets International Perspectives Requirement.

MICRO 374L: Insects and Our Health Laboratory

(Cross-listed with ENT). (0-3) Cr. 1. Alt. S., offered even-numbered years.

Prereq: Credit or enrollment in ENT 374

Laboratory and field techniques for studying medical or public health entomology, including: collection, identification and maintenance of medically significant arthropods and experimental design and execution related to the biology of arthropods or arthropod-pathogen interactions.

MICRO 402: Microbial Genetics and Genomics

(Dual-listed with MICRO 502). (Cross-listed with GEN). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: MICRO 302, Biol 313

The fundamental concepts of bacterial and bacteriophage genetics including mutagenesis, mechanisms of vertical and horizontal genetic information transfer and gene regulation are covered, along with genetic and genomic-based approaches to study these and other cellular processes of microorganisms. Review and discussion of research literature to examine experimental design, methodology, and interpretation of both historical and contemporary relevance to microbial genetics and genomics.

MICRO 407: Microbiological Safety of Foods of Animal Origins

(Dual-listed with MICRO 507). (Cross-listed with FS HN). (3-0) Cr. 3. F.S.

Prereq: MICRO 420

Examination of the various factors in the production of foods, from production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. Upon successful completion of this class, the student will receive both the Preventive Controls for Human Foods certificate (FDA program) and the International HACCP Alliance certificate (USDA-FSIS program).

MICRO 408: Virology

(3-0) Cr. 3. F.

Prereq: BIOL 313 or BBMB 301. BIOL 314 recommended

The molecular virology and epidemiology of human, animal, plant and insect viruses.

MICRO 420: Food Microbiology

(Cross-listed with FS HN, TOX). (3-0) Cr. 3. F.

Prereq: MICRO 201 or MICRO 302

Effects of microbial growth in foods. Methods to control, detect, and enumerate microorganisms in food and water. Foodborne infections and intoxications.

MICRO 421: Food Microbiology Laboratory

(Cross-listed with FS HN). (1-5) Cr. 3. S.

Prereq: MICRO 201 or MICRO 302; MICRO 201L or MICRO 302L. Credit or enrollment in FS HN/MICRO 420

Standard techniques used for the microbiological examination of foods. Independent and group projects on student-generated questions in food microbiology. Emphasis on oral and written communication and group interaction.

MICRO 428: Principles of Epidemiology and Population Health

(Cross-listed with V MPM, VDPAM). (3-0) Cr. 3. S.

Epidemiology of disease in populations. Disease causality, observational study design and approaches to epidemiologic investigations. This course is available on campus and by distance.

MICRO 430: Prokaryotic Diversity and Ecology

(Dual-listed with MICRO 530). (Cross-listed with BBMB). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: MICRO 302, MICRO 302L

Survey of the diverse groups of prokaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

MICRO 440: Laboratory in Microbial Physiology, Diversity, and Genetics

(Cross-listed with BBMB). (2-6) Cr. 4. F.S.

Prereq: MICRO 302, MICRO 302L, CHEM 332, BIOL 313L

Fundamental techniques and theory for studying the cellular mechanisms, genetic processes and diversity of microbial life. Experimental techniques will include isolation and physiological characterization of bacteria that inhabit different environments as well as an emphasis on genetic and molecular techniques to understand antibiotic resistance processes and mechanisms. Also included are techniques for phylogenetic characterization, measuring gene expression, and genetic manipulation of bacteria. Essential components for the effective communication of scientific results are also emphasized.

MICRO 450: Undergraduate Capstone Colloquium

(2-0) Cr. 2. S.

Prereq: SP CM 212 and senior standing in Microbiology

Required of all undergraduate majors in microbiology. Students demonstrate mastery of core courses in microbiology through discussion of current literature in microbiology and immunology, issues in scientific conduct, and bioethics in microbiology. Students present current papers in a journal club format and gain experience in writing and reviewing grant proposals.

MICRO 451: Survey in Microbiology

Cr. R. F.

Prereq: Junior or Senior standing in Microbiology

Preparations for graduation. Topics include job search strategies, career information, mock interviews, graduate and professional school application processes and guidelines as well as outcomes assessment activities.

MICRO 456: Principles of Mycology

(Cross-listed with BIOL). (2-3) Cr. 3. F.

Prereq: 10 credits in biological sciences

Morphology, diversity, and ecology of fungi; their relation to agriculture, industry, and human health.

MICRO 475: Immunology

(Dual-listed with MICRO 575). (3-0) Cr. 3. S.

Prereq: MICRO 310

An examination of humoral and cellular immune function as well as the interaction of the cells and factors of the immune system that result in health and disease. Micro 475L optional. Credit for either Micro 475 or V MPM 520, but not both, may be applied to graduation.

MICRO 475L: Immunology Laboratory

(2-4) Cr. 2. S.

Prereq: Credit or enrollment in MICRO 310 or MICRO 475 or MICRO 575

Techniques in primary culture and tumor cell growth, measures of lymphocyte function, serological techniques and flow cytometry. Half semester course.

MICRO 477: Bacterial-Plant Interactions

(Dual-listed with MICRO 577). (Cross-listed with PL P). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: 3 credits in microbiology or plant pathology

Overview of plant-associated bacteria including their ecology, diversity, and the physiological and molecular mechanisms involved with their interactions with plants. The course covers bacterial plant pathogens and pathogenesis, nitrogen fixation and plant symbioses, biological control and plant growth promotion, bacterial disease diagnosis and management, and approaches to the study of microbial communities in the rhizosphere and on leaves.

MICRO 485: Soil and Environmental Microbiology

(Dual-listed with MICRO 585). (Cross-listed with AGRON, ENSCI). (2-3) Cr. 3. F.

Prereq: AGRON 182 or equivalent; MICRO 201 and MICRO 201L recommended

The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

MICRO 487: Microbial Ecology

(Dual-listed with MICRO 587). (Cross-listed with BIOL, ENSCI, GEOL). (3-0) Cr. 3. F.

Prereq: Six credits in biology and 6 credits in chemistry

Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural and environmental systems. Consequences of microbial activity on water chemistry, weathering, and precipitation/dissolution reactions will be emphasized.

MICRO 490: Independent Study

Cr. 1-5. Repeatable, maximum of 6 credits. F.S.SS.

Prereq: A minimum of 6 credits of 300-level or above coursework in microbiology, permission of instructor

A maximum of 6 credits of Micro 490 may be used toward the total of 128 credits required for graduation.

MICRO 490A: Independent Study: Laboratory Research

Cr. arr. Repeatable. F.SS.

Prereq: A minimum of 6 credits of 300-level or above coursework in microbiology, permission of instructor

A maximum of 6 credits of Micro 490 may be used toward the total of 128 credits required for graduation.

MICRO 490B: Independent Study: Literature Review

Cr. arr. Repeatable. F.SS.

Prereq: A minimum of 6 credits of 300-level or above coursework in microbiology, permission of instructor

A maximum of 6 credits of Micro 490 may be used toward the total of 128 credits required for graduation.

MICRO 490C: Independent Study: Instructional Assistant

Cr. arr. Repeatable. F.SS.

Prereq: A minimum of 6 credits of 300-level or above coursework in microbiology, permission of instructor

A maximum of 6 credits of Micro 490 may be used toward the total of 128 credits required for graduation.

MICRO 490G: Independent Study: General

Cr. arr. Repeatable. F.SS.

Prereq: A minimum of 6 credits of 300-level or above coursework in microbiology, permission of instructor

A maximum of 6 credits of Micro 490 may be used toward the total of 128 credits required for graduation.

MICRO 490H: Independent Study, Honors

Cr. 1-5. Repeatable, maximum of 6 credits. F.S.SS.

Prereq: A minimum of 6 credits of 300-level or above coursework in microbiology, permission of instructor

A maximum of 6 credits of Micro 490 may be used toward the total of 128 credits required for graduation.

MICRO 495: Internship

Cr. 1-2. F.S.

Prereq: At least 6 credits of 300-level or above coursework in microbiology, approval of academic advisor

Participation in the Cooperative Extension Intern Program or an equivalent work experience. Written report of activities required. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:

MICRO 502: Microbial Genetics and Genomics

(Dual-listed with MICRO 402). (Cross-listed with V MPM). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: MICRO 302, Biol 313

The fundamental concepts of bacterial and bacteriophage genetics including mutagenesis, mechanisms of vertical and horizontal genetic information transfer and gene regulation are covered, along with genetic and genomic-based approaches to study these and other cellular processes of microorganisms. Review and discussion of research literature to examine experimental design, methodology, and interpretation of both historical and contemporary relevance to microbial genetics and genomics.

MICRO 507: Microbiological Safety of Foods of Animal Origins

(Dual-listed with MICRO 407). (Cross-listed with FS HN). (3-0) Cr. 3. F.S.

Prereq: MICRO 420

Examination of the various factors in the production of foods, from production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. Upon successful completion of this class, the student will receive both the Preventive Controls for Human Foods certificate (FDA program) and the International HACCP Alliance certificate (USDA-FSIS program).

MICRO 509: Plant Virology

(Dual-listed with MICRO 509). (Cross-listed with PL P). (2-0) Cr. 2. Alt. S., offered odd-numbered years.

Prereq: BIOL 313 or BBMB 301. BIOL 314 recommended.

Taxonomy, molecular mechanisms, host-interactions, vector transmission, epidemiology, detection, control and exploitation of plant viruses. Course will consist of a mixture of lectures, and student-led presentations using primary literature.

MICRO 517: Gut Microbiome: Implications for Health and Diseases

(Cross-listed with AN S, FS HN, V MPM). Cr. 3.

Prereq: 2-3 credits in microbiology and/or immunology.

Explore current research on gut microbiome including modern tools used to study the gut microbiome. Examine the linkages between gut microbiome and health status, diseases, and manipulation of gut microbiome to improve health.

MICRO 525: Intestinal Microbiology

(Cross-listed with V MPM). Cr. 3. Alt. S., offered even-numbered years.

Prereq: Micro 302, BIOL 313

Overview of commensal microbiota in the health and well-being of vertebrates. Topics include diversity of intestinal structure, microbial diversity/function, innate immune development, community interactions and metabolic diseases associated with alterations of the intestinal microbiome.

MICRO 530: Prokaryotic Diversity and Ecology

(Dual-listed with MICRO 430). (Cross-listed with BBMB). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: MICRO 302, MICRO 302L

Survey of the diverse groups of prokaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

MICRO 540: Livestock Immunogenetics

(Cross-listed with AN S, V MPM). (2-0) Cr. 2. Alt. S., offered odd-numbered years.

Prereq: AN S 561 or MICRO 575 or V MPM 520

Basic concepts and contemporary topics in genetic regulation of livestock immune response and disease resistance.

MICRO 551: Microbial Diversity and Phylogeny

(1-0) Cr. 1. F.

Prereq: MICRO 302, BIOL 313

Comparisons among the three kingdoms of life (Bacteria, Archaea, and Eukarya). Topics will include metabolism, adaptation, methods of phylogenetic analysis, and comparative genomics.

MICRO 552: Bacterial Molecular Genetics and Physiology

(1-0) Cr. 1. F.

Prereq: MICRO 302, BIOL 313

Review of genetics and selected physiological topics of model bacteria.

MICRO 553: Pathogenic Microorganisms

(1-0) Cr. 1. F.

Prereq: MICRO 302, BIOL 313

Review and contrast/comparison of common bacterial pathogens of plants and animals and their mechanisms of virulence, including toxins, protein secretion, host invasion and iron acquisition strategies. An overview of eukaryotic cell biology that is relevant to pathogenesis will also be included.

MICRO 554: Virology

(1-0) Cr. 1. S.

Prereq: MICRO 302, BIOL 313

Introduction to virus life cycles including entry, gene expression strategies, replication, and mechanisms to modify and overcome host defenses. The roles of specific viruses and sub-viral agents in animal and plant disease will also be included.

MICRO 555: Fungal Biology

(1-0) Cr. 1. S.

Prereq: GEN 313 or GEN 320 or equivalent.

Ecology, genetics, physiology and diversity of fungi, from yeasts to mushrooms, and their importance in human affairs.

MICRO 556: Ecology of Microorganisms

(1-0) Cr. 1. S.

Prereq: MICRO 302, BIOL 313

The study of microorganisms in their natural environments, with a focus on terrestrial and aquatic ecosystems, including eukaryotic hosts; interactions within biofilms and communities, including intercellular communication and symbioses; microbial adaptations to extreme environments; and metagenomic, genomic, molecular and microscopy techniques for the study of microbes in natural systems.

MICRO 575: Immunology

(Dual-listed with MICRO 475). (3-0) Cr. 3. S.

Prereq: MICRO 310

An examination of humoral and cellular immune function as well as the interaction of the cells and factors of the immune system that result in health and disease. Micro 475L optional. Credit for either Micro 475 or V MPM 520, but not both, may be applied to graduation.

MICRO 577: Bacterial-Plant Interactions

(Dual-listed with MICRO 477). (Cross-listed with PL P). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: 3 credits in microbiology or plant pathology

Overview of plant-associated bacteria including their ecology, diversity, and the physiological and molecular mechanisms involved with their interactions with plants. The course covers bacterial plant pathogens and pathogenesis, nitrogen fixation and plant symbioses, biological control and plant growth promotion, bacterial disease diagnosis and management, and approaches to the study of microbial communities in the rhizosphere and on leaves.

MICRO 585: Soil and Environmental Microbiology

(Dual-listed with MICRO 485). (Cross-listed with AGRON, ENSCI). (2-3) Cr. 3. F.

Prereq: AGRON 182 or equivalent; MICRO 201 and MICRO 201L recommended

The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

MICRO 586: Medical Bacteriology

(Cross-listed with V MPM). (4-0) Cr. 4. F.

Prereq: 310

Bacteria associated with diseases of vertebrates, including virulence factors and interaction of host responses.

MICRO 587: Microbial Ecology

(Dual-listed with MICRO 487). (Cross-listed with EEOB, ENSCI, GEOL). (3-0) Cr. 3. F.

Prereq: Six credits in biology and 6 credits in chemistry

Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural and environmental systems. Consequences of microbial activity on water chemistry, weathering, and precipitation/dissolution reactions will be emphasized.

MICRO 590: Special Topics

Cr. 1-5. Repeatable. F.S.SS.

Prereq: Permission of instructor

Courses for graduate students:

MICRO 604: Seminar

(1-0) Cr. 1. Repeatable. F.S.

Course will expose students to the breadth of subdisciplines within microbiology, offer opportunities for direct interaction between the students and the faculty members within the Interdepartmental Microbiology Graduate Program, and promote interactions among the students within the program. Offered on a satisfactory-fail basis only.

MICRO 608: Molecular Virology

(Cross-listed with PL P, V MPM). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: BBMB 405 or GDCB 511

Advanced study of virus host-cell interactions. Molecular mechanisms of viral replication and pathogenesis.

MICRO 615: Molecular Immunology

(Cross-listed with BBMB, V MPM). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: BBMB 405 or BBMB 506 and BBMB 507

Current topics in molecular aspects of immunology: T and B cell receptors; major histocompatibility complex; antibody structure; immunosuppressive drugs and viruses; and intracellular signaling pathways leading to expression of genes that control and activate immune function.

MICRO 625: Mechanisms of Bacterial Pathogenesis

(Cross-listed with V MPM). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: Credit in Biochemistry and Microbiology.

Review of current concepts in specific areas of microbial pathogenesis including the genetic basis for bacterial disease, genetic regulation and control of virulence factors and their mechanisms of action, and host-pathogen interactions at the cellular and molecular levels. The application of microbial genetics to understanding pathogenesis will be included.

MICRO 626: Advanced Food Microbiology

(Cross-listed with FS HN, TOX). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: FS HN 420 or FS HN 421 or FS HN 504

Topics of current interest in food microbiology, including new foodborne pathogens, rapid identification methods, effect of food properties and new preservation techniques on microbial growth, and mode of action of antimicrobials.

MICRO 627: Rapid Methods in Food Microbiology

(Cross-listed with FS HN, TOX). (2-0) Cr. 2. Alt. F., offered even-numbered years.

Prereq: FS HN 420 or FS HN 421 or FS HN 504

Provides an overview of rapid microbial detection methods for use in foods. Topics include historical aspects of rapid microbial detection, basic categories of rapid tests (phenotypic, genotypic, whole cell, etc.), existing commercial test formats and kits, automation in testing, sample preparation and "next generation" testing formats now in development.

MICRO 685: Advanced Soil Biochemistry

(Cross-listed with AGRON, ENSCI). (2-0) Cr. 2. Alt. S., offered even-numbered years.

Prereq: AGRON 585

Chemistry of soil organic matter and biochemical transformations brought about by microorganisms and enzymes in soils.

MICRO 690: Current Topics

Cr. 1-3. Repeatable. F.S.SS.

Prereq: Permission of instructor

Colloquia or advanced study of specific topics in a specialized field.

MICRO 690A: Current Topics: Microbiology

Cr. 1-3. Repeatable. F.S.SS.

Prereq: Permission of instructor

Colloquia or advanced study of specific topics in a specialized field.

MICRO 690B: Current Topics: Immunology

Cr. 1-3. Repeatable. F.S.SS.

Prereq: Permission of instructor

Colloquia or advanced study of specific topics in a specialized field.

MICRO 690C: Current Topics: Infectious Diseases

Cr. 1-3. Repeatable. F.S.SS.

Prereq: Permission of instructor

Colloquia or advanced study of specific topics in a specialized field.

MICRO 692: Molecular Biology of Plant-Pathogen Interactions

(Cross-listed with PL P). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: PL P 506 or BBMB 405 or GEN 411 or MICRO 402 or strong background in molecular biology

Seminal and current research in molecular and physiological aspects of plant interactions with pathogens, including mechanisms of pathogenesis, host-pathogen recognition and host defense, with an emphasis on critical evaluation of primary literature. Students also complete a research proposal writing and peer review exercise.

MICRO 697: Graduate Research Rotation

Cr. arr. Repeatable. F.S.

Graduate research projects performed under the supervision of selected faculty members in the Interdepartmental Microbiology major.

MICRO 698: Seminar in Molecular, Cellular, and Developmental Biology

(Cross-listed with BBMB, GDCB, MCDB, V MPM). (2-0) Cr. 1-2. Repeatable.

S.

Student and faculty presentations.

MICRO 699: Research

Cr. arr. Repeatable.