

Interdisciplinary Training, Education and Research in Food-Energy-Water Systems NRT Program Trainee Handbook for Cohorts 1-3



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This is the InTERFEWS Trainee Handbook for Cohorts 1-3. Cohort 4 has a separate handbook with a different program timeline and funding information due to having to spend NSF grant funds by a certain date before the end of the program. Please be sure you are viewing the correct handbook based on your cohort!

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InTERFEWS Purpose

As population continues to grow and demands for resources increase, understanding the nexus of Food-Energy-Water Systems (FEWS) is vital to ensure the reliability and equity of access to these crucial resources. FEWS are tightly intertwined and characterized by complex tradeoffs that are not yet well understood. Understanding the demands for and tradeoffs amongst FEW resources is particularly challenging in semi-arid regions, where increasing population trends are likely to continue, and water shortage poses risks to agriculture and energy industries.

The Interdisciplinary Training, Education and Research in Food-Energy-Water Systems (InTERFEWS) Program brings together PhD students from traditionally disparate disciplines to conduct research on key problems in the FEW nexus with a focus on water-scarce, arid regions.

Interfews Mission

Prepare a diverse cohort of graduate students with the transdisciplinary and systems-level thinking skills necessary to make meaningful contributions to the complex and changing interactions in Food-Energy-Water Systems (FEWS) under water scarcity.



PROGRAM

The InTERFEWS program was designed to equip students with 21st century career skills, preparing graduates to solve complex problems.



RESEARCH

Research activities are focused on technological, infrastructural, policy, and institutional innovations that foster sustainable FEWS in a changing world.



PARTNERS

We have partnered with several companies, NGOs and government agencies to host students for apprenticeships during the program.

Colorado State University is uniquely poised to address semi-arid FEW issues due to its strong research engagement in managing resources under scarcity, its location in the Rocky Mountain Western Region, and its culture of collaborative innovation.

8 30 9 30+ Colleges Departments Core Faculty Partners

Interfews Goals

The overarching goal of InTERFEWS is to prepare a diverse cohort of graduate students with skills and knowledge necessary to make meaningful contributions to the complex and changing interactions in FEWS in semi-arid regions. To foster a systematic evaluation of InTERFEWS outcomes, the team's goals for education, research, and training are organized into three categories: programmatic, student-centered and institutional.

PROGRAMMATIC GOALS

Build institutional capacity at CSU to initiate transdisciplinary careers and enhance student capacity to address FEWS issues. Outcomes related to programmatic goals are to develop:

- Capacity to educate students to address complex FEWS issues via systemsthinking transdisciplinary education and research;
- A culture of collaboration and transdisciplinary research fostered via team science training;
- Successful, sustainable transdisciplinary courses focused on applying evidence-based approaches and synthesizing faculty expertise; and
- Programs that provide students with the skills to work effectively with relevant communities, communicate with stakeholder groups, and accessibly disseminate knowledge of FEWS issues and research results to audiences that may lack high-level technical knowledge.

STUDENT-CENTERED GOALS

Advance student competency for transdisciplinary problem-solving, participatory methods, and systems-thinking to address FEWS challenges, and foster a culture of collaboration and communication. Outcomes related to the student-centered goals are to develop:

- Capacity to understand and consider tradeoffs and interconnections among FEW sectors in semiarid regions with scarce water resources;
- Ability to apply tools for integrative analysis and design, develop, test and implement cyber elements that facilitate improved management of FEWS;
- Capacity to synthesize broad, integrated perspectives on the interactions among natural and built infrastructure and socioeconomic and policy considerations, including social and environmental justice and public health outcomes;



STUDENT-CENTERED GOALS (continued)

- Skills to successfully engage and authentically involve stakeholders in the decision-making process through transdisciplinary skills gained, via experience conducting community-based studies with participatory aspects;
- Ability to communicate across disciplines and understand jargon, perspectives, and the conceptual frameworks used outside of their core discipline; and
- Networks of colleagues that will support achievement of future career goals.

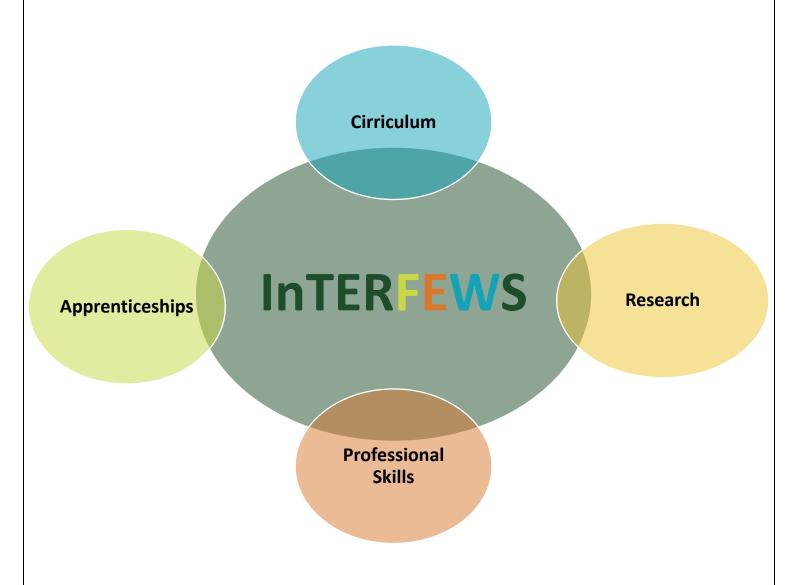
INSTITUTIONAL GOALS

Develop a path to overcome barriers associated with transdisciplinary education. Outcomes related to the institutional goal are to develop:

- Enhanced opportunities for students to engage in graduate coursework that bridges their disciplinary home to new areas, including infusion of STEM disciplines with social science methods and community-based approaches;
- Institutional capacity to offer interdisciplinary courses that are team taught by several faculty members from different departments; and
- Increased uptake of successful practices by disseminating findings to the broader STEM education, FEWS, and transdisciplinary research communities.

InTERFEWS Components

Intervel Intervel education and training program consisting of four main components:



InTERFEWS Components

CURRICULUM

A curriculum has been developed that includes two new graduate-level InTERFEWS courses to specifically address FEWS issues. These courses will supplement a variety of disciplinary courses already in existence at CSU from which trainees can select.

- Completion of two core InTERFEWS courses
 - CIVE/GES 528: Assessing the Food, Energy, Water Nexus (fall semester – 1st semester in program)
 - CIVE 527: Tools for Food-Energy-Water Systems Analysis (spring semester – 2nd semester in program)
- Completion of GRAD 550 (differs by cohort, but typically completed in 1st year or within three semesters of being in the program)
- Completion of two FEW- related elective courses outside of the trainee's core area of knowledge
 - Technical FEW-related course outside core area of knowledge
 - o Policy/economics FEW-related course outside core area of knowledge
- Completion of required courses in Approved Plan of Study for trainee's department (41-47 credits, depending on department)

RESEARCH

Transdisciplinary and collaborative research will be fostered to address technical, social, and policy issues for FEWS. Trainees will choose (although some will do both) between:

- Including a chapter in their dissertation that is an interdisciplinary assessment or systems-level analysis of a FEW topic; AND/OR
- Co-author and publish an interdisciplinary/transdisciplinary, peer-reviewed FEW article that that includes researchers from different disciplines.

Please see pages 15-16 for additional details on this requirement.

PROFESSIONAL SKILLS

Trainees will participate in transdisciplinary and communication skills training to enhance capacity to work in transdisciplinary teams, communicate complex topics, and elicit and respond to stakeholder input.

 EMBeRS Workshop: The Employing Model-Based Reasoning in Socio-Environmental Synthesis (EMBeRS; DGE-1545404) student workshop is an intensive, week-long training experience to develop capacity for leading interdisciplinary synthesis efforts in the future by bringing together students from different disciplines around local resource allocation related to water scarcity, and the issues surrounding the management of each.

InTERFEWS Components

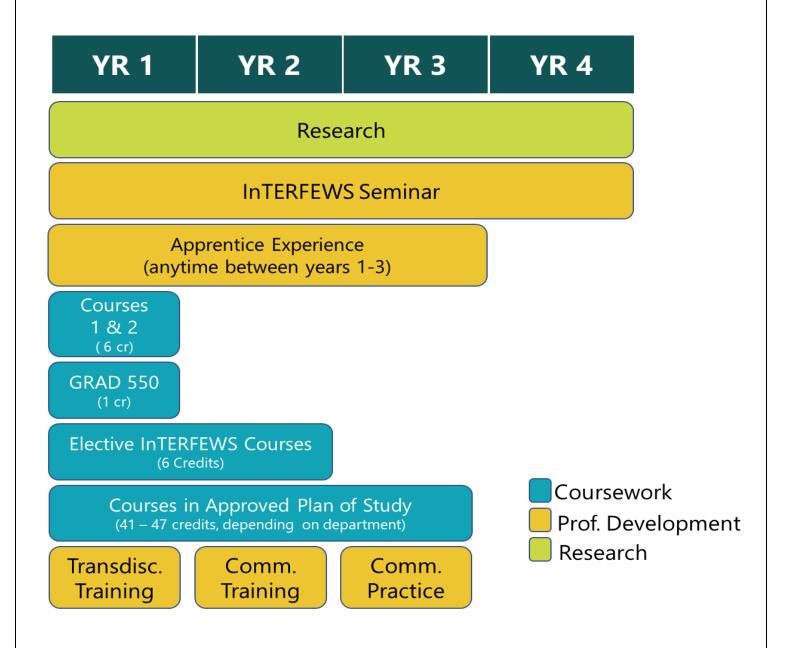
- Communications workshop: 2-day communications workshop to improve written and oral communication skills.
 - Intervelose of choice will meet the required to practice the learned skills in formats that includes assessment by peers and mentors using rubrics developed during the workshop dates with facilitators. Presentations can be completed during CSU events (e.g., Hydrology Days, Graduate Student Showcase, SoGES Public Panels, etc.), during community meetings, etc., but prior approval is necessary. Trainees should reach out to the Intervelose Program Coordinator ahead of time to obtain approval that their venue of choice will meet the requirements for the oral practicum experience.

APPRENTICESHIPS

Trainees will participate in apprenticeships on FEW topics organized through partnerships with industry, government agencies and NGOs. The apprenticeships will provide trainees with experiences they would not necessarily receive through their research and courses, with a focus on gaining 21st Century competencies important for doctoral degree recipients to enter diverse careers (competences adapted from the National Academies of Sciences, Engineering and Medicine Report on Graduate STEM Education for the 21st Century (2018)). Trainees should discuss potential opportunities with their advisors and/or mentors. We have partnered with several companies, NGOs, and government agencies to serve as advisory members, help guide our research efforts, propose collaborative research topics and apprenticeship opportunities, etc., so if ideas, connections and/or specific opportunities are needed, contact the InTERFEWS Program Coordinator who will reach out to the leadership team.

- Once an opportunity has been identified, trainees will complete a short write-up
 (a few sentences to a paragraph) summarizing what the apprenticeship entails,
 relation to FEW, and what you will be doing including any products you would
 create. The leadership team will review and approve the summary.
- Trainees and their apprenticeship supervisors will then complete the guidelines
 document in their Apprenticeship electronic portfolio folder. The leadership team
 will approve this document, and then contracts will be sent to the trainee and
 supervisor to sign *before* the apprenticeship begins.
- Upon completion of the apprenticeship, trainees will complete a brief report (1-2 pages) documenting their experience and achievement of the agreed upon goals, including any changes made to those goals and the reason for the change. The supervisor will approve the report before submitting it for review to the leadership team.
- The guidelines/contract document, completion report, and any products from the apprenticeship should be uploaded to trainees' Apprenticeship electronic portfolio folder.

InTERFEWS Timeline



InTERFEWS Important Program Notes

NOTE: Program Flexibility

Although there are requirements that all trainees must complete, the program does allow for some flexibility in order for trainees to get the most out of the program. Examples of where flexibility in the program exists includes electives courses not listed on the approved list that may be more beneficial to the trainee than those already vetted, a venue for the trainee to practice their oral or written communication skills that has not been suggested in the handbook, etc. The trainee should first discuss the possibilities with their advisor and/or mentor, and if they agree, the trainee should then contact the InTERFEWS program (interfews@colostate.edu) so the leadership team can review the request.

NOTE: Funding Flexibility for Cohort 3 and 4 Trainees

Although previous cohorts of funded trainees had the ability to defer their funding to a later date, as InTERFEWS is now nearing the end of our grant cycle and the funds must be used by a certain date, funded trainees in cohorts 3 and 4 will have less flexibility for funding deferral. Cohort 3 funded trainees may defer funding their first year in the program but must utilize their funding the following two consecutive years. Cohort 4 funded trainees will need to use their funding the first two consecutive years in the InTERFEWS program.

Interventions Interventions

The InTERFEWS National Research Traineeship entails significant prestige and commitment. The curriculum will help you become a leading FEWS problem solver, prepared to tackle some of the most pressing environmental issues. While some trainees may find that immersion in the InTERFEWS program is challenging, we hope it will be rewarding as well. Your selection as a trainee signifies our confidence in you, your abilities, and your willingness to explore transdisciplinary FEW systems. We will support you in the hope that you will thrive in this environment, contribute to the success of the program, and ultimately, become a leader in solving complex FEWS problems. By accepting this traineeship, we expect that you stay actively engaged in the InTERFEWS program throughout your doctoral studies, and hopefully, beyond. Trainees are expected to take all InTERFEWS components seriously and to put forth their best effort for every aspect of the program. Trainees are also expected to maintain a good standing with their respective department's program requirements.

Acceptance into InTERFEWS and Funding

The InTERFEWS Program is offered to accepted Colorado State University PhD students, and preference is given to those entering the 1st or 2nd semester of their program (those beyond their 3rd semester are not eligible in order to ensure they can complete the InTERFEWS requirements without prolonging graduation in their PhD program). Both funded and unfunded positions are offered. To receive a funded position, which includes tuition coverage and a stipend, trainees must be US citizens.

Funded InTERFEWS trainees will be supported for 1-2 years by the program, and for 1-2 years by their selected mentor. Funded trainees will receive \$34,000 per year for 1-2 years, as well as financial support for tuition and fees. Funded trainees should receive 12 continuous months of stipend support over an annual period, unless they are allowed an interruption to pursue a funded, career-enhancing research opportunity (e.g., internship, international research opportunity). If an interruption is approved by all the necessary entities (leadership team, NSF, Sponsored Programs, advisor/department), then the trainee must receive the balance of their 12-month support, over a comparable time interval, immediately upon conclusion of the approved, funded interruption. For reporting purposes, the 12-month funding periods should begin on August 15 and go to August 14 of the following year. Funded trainees should not take on other paid positions at (e.g., GRA, GTA, etc.) while they are receiving InTERFEWS funding.

Unfunded trainees will not receive a stipend or tuition coverage from the program, but they will be eligible to receive other benefits offered to InTERFEWS trainees (e.g., research support funds, such as travel and research supply funds) and will participate in the same curriculum and professional development activities as funded trainees. All trainees will be eligible for research support funds, but a competitive process will require trainees to write short proposals to receive the funds. Research support funds will be allocated dependent upon trainees' need for supplies, as well as what and how much is requested in the competitive process.

Interventions Interventions

PhD Advisors and InTERFEWS Mentors

Each trainee is responsible for selecting their PhD advisor in their respective PhD program department. Although some CSU departments require a PhD advisor selection upon acceptance to a program, some do not. Trainees who are not required to select a PhD advisor upon acceptance to CSU are expected to choose their advisor by their department's required deadline and to inform the InTERFEWS Program Coordinator when that choice has been made. The InTERFEWS leadership team will initially assign each trainee one InTERFEWS mentor upon entering the program. InTERFEWS mentors are part of the Core InTERFEWS mentor trainees on interdisciplinary aspects of their research. Trainees can request to change their designated InTERFEWS mentor at any time during their program and can do so by contacting the Program Coordinator. The Program Coordinator and Director will assist the trainee in matching them with a new mentor that will help further the interdisciplinary elements of their research. The following are the responsibilities of advisors and InTERFEWS mentors:

Advisor

- Provide funding via a research project (e.g., RA) or department resources (e.g., TA) for 1-2 years. This financial support may be provided during any year during the trainee's PhD program.
- Mentor the trainee to conduct interdisciplinary research that addresses FEWS topics
 - One chapter of trainee's dissertation must an interdisciplinary assessment or systems level analysis of a FEWS topic; OR they need to co-author and publish an interdisciplinary/transdisciplinary, peer-reviewed FEW article that includes researchers from different disciplines.
- Guide the trainee to complete InTERFEWS Curriculum requirements (years 1 – 2)
 - Enrollment in two InTERFEWS core courses

InTERFEWS Mentor

- Mentor the trainee to conduct interdisciplinary research that addresses FEWS topics
 - One chapter of trainee's dissertation must an interdisciplinary assessment or systems level analysis of a FEWS topic; OR they need to co-author and publish an interdisciplinary/transdisciplinary, peer-reviewed FEW article that includes researchers from different disciplines.
- Guide the trainee to complete InTERFEWS Curriculum requirements (years 1 – 2)
 - Enrollment in two InTERFEWS core courses
 - Enrollment in GRAD 550: STEM Communication
 - Enrollment in at least one technical course and one policy/economics

- Enrollment in GRAD 550: STEM Communication
- Enrollment in at least one technical course and one policy/economics course outside of the trainee's core area of knowledge
- Support the trainee to participate in Professional Development workshops (completed years 1 – 3)
- Provide time and guidance for the trainee to participate in an apprenticeship (completed year 2)
 - Participation in an apprenticeship is required for a duration of 3 weeks up to 4 months that offers new skill or experience that would not be offered through dissertation research.
- Serve on the dissertation committee for the trainee
- Attend annual team meeting
- Participate in evaluation activities

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- Provide time and guidance for the trainee to participate in an apprenticeship (completed year 2)
 - Participation in an apprenticeship is required for a duration of 3 weeks up to 4 months that offers new skill or experience that would not be offered through dissertation research.
- Serve on the dissertation committee for the trainee (exceptions made on caseby-case basis)
- Attend annual team meeting
- · Participate in evaluation activities

Electronic Portfolio and Individual Development Plans

To enhance mentor-mentee relationships and identify any issues trainees may face, electronic portfolios have been created and stored on a shared Google Drive that is accessible to the trainee, their designated InTERFEWS mentor and PhD advisor, as well as the InTERFEWS Program Coordinator. The electronic portfolio will contain the trainee's annual Individual Development Plan (IDP) and evidence of their professional development, knowledge and skills related to FEWS research. Trainees will be required to use the Individual Development Plan (IDP) to identify professional goals through a self-assessment, and it will provide communication tools between trainees and their advisors (and InTERFEWS mentors, if they choose to include them in this process). The CSU Graduate School offers an interactive, online tool to support graduate student use of an IDP which should be used and updated annually. Trainees are expected to prepare their IDPs annually during the spring semesters and review them with their PhD advisors before the end of the semester. In addition to annual IDP reviews, portfolios should also be reviewed and discussed by trainees with their advisors annually. Summary reports will then be provided to the evaluator by advisors at the end of each year for each trainee.

Interdisciplinary Chapter OR Published, Peer-Reviewed Interdisciplinary Article Requirement

Trainees must complete <u>one</u> of the following before graduation, although some may choose to do both:

- Include a chapter in their dissertation that includes an interdisciplinary assessment or systems-level analysis of a FEW topic; AND/OR
- Co-author and publish an interdisciplinary/transdisciplinary, peer-reviewed FEW article that includes researchers from different disciplines.

These items will be assessed by the InTERFEWS leadership team using a protocol developed by Misra et al. (2015) for assessing the interdisciplinarity and policy/decision making relevance of interdisciplinary publications and two problem-solving frameworks covered in the InTERFEWS program: the EPA Eco-Health Driver-Pressure-State-Impacts-Responses Framework (Bradley and Yee, 2015) and the Complex Problem Solving for Sustainability Competencies Framework (Wiek et al. 2011, 2016). The goal of the protocol/rubric is not to grade trainees on their research approach, but instead to learn how the InTERFEWS program prepares students to address FEWS nexus research.

Interdisciplinary Chapter Requirement:

For the interdisciplinary FEW chapter requirement, you need to include each of the following three sections described below (Overview, Intellectual Merits, and Broader Impacts). Each section should be clearly labeled with these titles and discussed in reference to your research.

- 1) Overview A description of the research covered in the chapter. At least one of the following (a c) needs to be addressed in the overview but could include more than one/all three. Regardless of how many of the follow sub-sections are included in the overview, all three need to be labeled and simply note if any were not covered in your chapter.
 - a) Interdisciplinary Considerations
 - b) System-Thinking Considerations
 - c) Stakeholder Engagement

Additionally, all overviews must include the following sub-section:

- d) Research in Context of Drivers, Pressures, States, Impacts, Response (DPSIR) Framework
 - i) This sub-section should either frame your research in the context of the DPSIR framework, or at minimum describe your research using some or all of the terms in the DPSIR framework.
- 2) <u>Intellectual Merit</u> A description of the potential for your research to advance knowledge.
- 3) <u>Broader Impacts</u> A description of the potential for your research to benefit society and contribute to the achievement of desired society outcomes. Use of your research in practical applications, development of policy, management and decision making.

In other words, #1-3 must be included in your chapter with the section titles labeled as such. For a – c under #1 (Overview), at least one must be addressed (although can include as many as you would like), but all three sub-sections must be titled as such, noting if you did not address any of them in your chapter. Use of DPSIR Framework (1d) must be included in your overview.

Peer-Reviewed Interdisciplinary Article Requirement:

If you choose to co-author and publish an interdisciplinary/transdisciplinary, peer-reviewed FEW journal article that includes co-authors from other disciplines, it should be accompanied by a one page summary document that includes the following three sections described below (Overview, Intellectual Merits, and Broader Impacts). Each of the following sections should be clearly labeled with these titles and discussed in reference to your research in the accompanying one-page summary document.

- Overview A description of the research covered in the chapter. At least one of the following (a – c) needs to be addressed in the overview but could include more than one/all three. Regardless of how many of the follow sub-sections are included in the overview, all three need to be labeled and simply note if any were not covered in your chapter.
 - a) Interdisciplinary Considerations
 - b) System-Thinking Considerations
 - c) Stakeholder Engagement

Additionally, all overviews must include the following sub-section:

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In other words, #1-3 must be included in your accompanying 1-page summary document with the section titles labeled as such. For a – c under #1 (Overview), at least one must be addressed (although can include as many as you would like), but all three sub-sections must be titled as such noting if you did not address any of them in your article. Use of DPSIR Framework (1d) must be included in your overview. Although not required, it would be desirable to include a one-page summary of these three sections as part of your dissertation appendices.

Responsible Conduct of Research (RCR) Training

CSU requires students receiving NSF federal funding to complete both the online training AND a face-to-face training course. All trainees should complete the online training as soon as possible upon starting the InTERFEWS program. Trainees must complete the face-to-face training course within the first year they are in the program. The face-to-face course requirement is optional for unfunded trainees, but <a href="https://disable.courses.cour

Evaluation

In addition to participating in the four components of the InTERFEWS program, trainees are expected to participate in all evaluation activities organized by the program's external evaluator. The purpose of evaluating the InTERFEWS program is to enable continuous improvement of the program and ensure trainees are receiving the intended outcomes. The following are just some of the evaluation activities trainees will be expected to complete: entry survey (self-assessment, prior to first InTERFEWS class), program evaluation surveys (trainee feedback, various times), exit survey (self-assessment, end of year 3), follow-up survey (at end of NRT program), completion and/or review of several evaluation protocols for different InTERFEWS events and program requirements, and participation in the annual meeting/focus group. Trainees are required to sign and return the informed consent form to participate in the evaluation research prior to the completion of the entry survey and prior to the first day of InTERFEWS course 1 during the first semester of their program.

InTERFEWS Trainee Requirements Checklist

Contracts (prior to start of 1 st semester)
Trainee contract signed and returnedInTERFEWS Mentor and PhD advisor contracts signed and returned
Orientation (1 st semester of year 1)
☐ Participation in trainee orientation during 1st semester of NRT program
Electronic Portfolio & IDP ☐ Individual Development Plan (IDP) completed/updated by trainee and reviewed annually with advisor (and mentor, at discretion of trainee) towards the end of each spring semester ☐ Portfolios updated by trainee and then reviewed by advisor toward the end of each spring semester
Interdisciplinary Research that Addresses FEWS Topics (years 1 – 4)
One dissertation chapter must include an interdisciplinary assessment or systems-level analysis of a FEW topic, AND/OR the trainee must co-author and publish an interdisciplinary/transdisciplinary, peer-reviewed FEW article that that includes researchers from different disciplines (p.15-16 for details).
InTERFEWS Curriculum (years 1 – 2)
Two InTERFEWS core courses Understanding the FEW Nexus (1 st semester, Fall, 3 credits) Tools for Analysis of FEWS Issues (2 nd semester, Spring, 3 credits)
GRAD 550: STEM Communication GRAD 550 (1 credit)
One technical elective course and one policy/economics elective course outside of the trainee's core area of knowledge Technical Course outside core area of knowledge Policy/Economics Course outside core area of knowledge
Required courses in Approved Plan of Study for trainee's department 41-47 credits, depending on department
Participation in Professional Development Workshops (years 1 – 3)
 EMBeRS week-long student workshop InTERFEWS seminars and existing professional development opportunities at CSU (e.g., Graduate Student Showcase). Information provided to trainees as events are announced

InTERFEWS Trainee Requirements Checklist

Communications Training and Practice Experiences (years 1 – 4)
 □ Participation in communications workshop dates □ Written Practice Experience: Article written for one of CSU's major FEW-related centers/institutes (Colorado Water Center, Energy Institute, SoGES or One Water Solutions Institute). Article will be peer reviewed with a rubric requirement before submission □ Oral Practice Experience: Presentation to a minimum of 10 stakeholders (at least four will complete rubric, and not all four can be academics) with completed rubric requirement Apprenticeship (completed year 1 – 3)
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 Participation in an apprenticeship for a duration of at least 3 weeks that offers new skills training or experience that would not be offered through dissertation research Completion of apprenticeship report, approved by apprenticeship sponsor, and turned in to program coordinator
Evaluation Participation (years 1 – 4)
 Signed Informed Consent Form to participate in evaluation research (prior to first InTERFEWS class and trainee entry survey) □ Trainee entry survey (self-assessment, prior to first InTERFEWS class) □ Program evaluation surveys (trainee feedback, various times) □ Trainee exit survey (self-assessment, end of year 3) □ Trainee follow-up survey (at end of NRT program) □ Completion and/or review of several Evaluation Protocols for different InTERFEWS events and program requirements □ Participation in the annual meeting/focus group
Responsible Conduct of Research (RCR) Training
 Online Training (completed 1st semester) Face-to-Face Training Course (optional for unfunded trainees, but highly encouraged; completed within 1st year)

InTERFEWS Project Team Directory



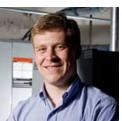
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