**An Empirically and Theoretically Grounded Design Process**

**Step 1: Literature Review**
Review literature to identify elements of the knowledge base for teaching teachers and approaches for developing science teachers' CKT.

**Step 2: Focus Groups**
Meet with elementary science teacher educators of content and methods courses to understand needs.

**Step 3: Design Heuristics**
Use the literature and focus group data to generate three overarching design heuristics (shown below).

**Step 4: Develop Educative Features**
Use the design heuristics to develop educative features within a prototype packet (shown on right).

**Step 5: Review Prototype**
Focus group, advisory board, and initial users review prototype packet and provide feedback.

**Step 6: Revise Prototype**
Revise final prototype using feedback. Repeat process to develop new packets.

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**Design Heuristics**

**Heuristic #1: Support Teacher Educators in Engaging Elementary Teachers in the Work of Teaching Science**
- CKT Resource Packets should help teacher educators adapt and use resources appropriately.
- Packets can make explicit how specific science teaching practices correspond to different concepts and ideas and provide recommendations for how those might be introduced to preservice teachers in different contexts and courses.

**Heuristic #2: Support Teacher Educators in Anticipating, Understanding, and Addressing Elementary Teachers’ Ideas about Science and Science Teaching**
- CKT Resource Packets should support teacher educators in anticipating, eliciting, and interpreting preservice teachers’ ideas, and provide insight into how teachers educators might address those ideas.
- Packets can give suggestions of assessment probes, discussion questions, and activities likely to confront preservice teachers’ initial thinking about teaching science in productive ways.

**Heuristic #3: Support Teacher Educators in the Development of Elementary Teachers’ Content Knowledge**
- CKT Resource Packets should help teacher educators support preservice teachers in assessing their own understanding, confronting gaps in their understanding or misconceptions, making connections across concepts, and understanding why CKT is important.
- Materials should emphasize differences between the understanding required of teachers and students.

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**CKT Packets: Sample Educative Features**

**About the Task**
Background information for the targeted content and work of teaching science categories, NGSS connections, assessment boundaries and potential grade-level alignment.

**Elaborated Answer Key**
An elicitation task to assess preservice teachers' CKT, including incorrect/correct responses and reasoning that might support different responses.

**Lesson Plans**
Annotated and extended lesson plans outline how to engage preservice teachers with the CKT tasks.

**Reading Pages**
Information about the science content and work of teaching science ideas elementary students are intended to develop.

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**Next Steps**
- Develop a total of 6-8 packets that target various intersections of the Work of Teaching Science and Science Content Ideas.
- Efficacy Study
  - Implement a quasi-experimental design utilizing a cohort-control model to study efficacy of the materials.
- Dissemination
  - CKT resource packets and a CKT assessment tool will be available for use in preservice teacher education programs and in-service teacher professional development.