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## HH: PER Assessment Tools II

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7/9/2024 | 3:00 PM to 4:00 PM  
Room: Mezzanine Level - Douglass

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*Moderator: Paul DeStefano*

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*(HH-02 3:12 PM-3:24 PM) | Contributed Talk (12 Minutes) | Introductory and advanced students' difficulties with heat transfer using a validated conceptual survey instrument*

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Presenting Author: Mary Brundage, University of Pittsburgh

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Additional Author | David E Meltzer, Arizona State University

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Additional Author | Chandralekha Singh, University of Pittsburgh

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We use the Survey of Thermodynamic Processes and First and Second Laws-Long (STPFaSL-Long), a research-based survey instrument with 78 items at the level of introductory physics, to investigate introductory and advanced students' difficulties with heat transfer. We present an analysis of data from 12 different introductory and advanced physics classes at five different higher education public institutions in the US in which the survey was administered in-person to more than 1000 students. We find that not only introductory but also advanced physics students have many common difficulties with these introductory thermodynamic concepts after traditional lecture-based instruction in relevant concepts. These findings are consistent with prior research in this area, but our results are also for several new contexts in addition to those used in prior research and for large numbers of both introductory and advanced students. Findings related to common difficulties of students with these concepts before and after traditional instruction in college physics courses can help instructors of these courses improve student understanding of these concepts. These findings can also be valuable for developing effective research-based curricula and pedagogies to reduce student difficulties and help students develop a functional understanding of heat transfer.