We describe the Learn-Train-Ask workflow that guides participants through learning domain-specific content, process training to frame their intuitions as hypotheses, and collaborating with anonymous peers to brainstorm related questions. 344 voluntary online participants from 27 countries created 399 personally-relevant questions about the human microbiome over 4 months, 75 (19%) of which microbiome experts found potentially scientifically novel.

More broadly, people have followed their personal intuitions to design and build products that meet their needs.

When are such personal experiences worth paying attention to? For every intuition proven right, many more may be closer to snake oil—e.g., the widespread belief in the utility of probiotics despite limited evidence [6].

Current online forum designs prioritize discussion — sharing personal details in long, free-flowing text—over structure, succinctness, learning, and potential scientific utility.

This paper contributes (1) the Learn-Train-Ask method for people to perform personally meaningful scientific work by sharing personal insights and receiving feedback from others, and (2) its embodiment in Docent — a novel crowdsourcing system for causal scientific questions. Docent enables novices to ask useful questions by learning domain-specific content, undergoing process training to develop task-specific skills, and collaborating with online peers.

People can offer more than just their data and perceptual skills: they create theories, right or wrong, about a wide range of topics including emotions [19], motivation [30], or diet. These may be observational theories [22], folk theories passed in a family/culture across generations [13], or ideas brainstormed in online communities [1]. Perhaps, these intuitions can provide a starting point for personally meaningful scientific work that also assists the scientific community.

This work explores how online learning and process training systems, combined with peer collaboration, can help people learn similar skills that can be useful in scientific and design domains. Transforming intuitions into falsifiable questions is a key skill for scientists and designers alike. How can people create questions that are novel (contain new information), useful (relate to and potentially extend existing scientific knowledge), easy to answer, and specific (relate to only one topic)? Such questions can potentially accelerate research in nascent scientific domains, such as the human microbiome.

**Learn content: Integrate Concepts with Insights**

**Process training: From Intuitions to Scientific Questions**

**GutBoard: Crowd responses, Discussion, Expert feedback**

We hypothesize that content learning more clearly helped because domain knowledge provided insights and, potentially, ideas for questions, whereas the benefits for training heuristics were less clear.

The best questions had three features: they shared a clear insight from the participants’ life (frequently elaborated upon in the discussion section of the question), enabled others to answer them from their lifestyle, and linked to known microbiome research (Table 3). Common question themes included probiotics; fermented foods; the consumption of fruits and vegetables in different forms; medicine usage; activities like exercises; stool quality & consistency.