**Table S1.** Examples of students in each level and associated feature of KiP.

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| **Level** | **KiP Feature** | **Transcript excerpt** | |
| **1** | P-prim: more is more  Intuitive reasoning | Interviewer:  Benjamin: | How is it possible to eject more electrons?  More energy…All I know is more energy, to knock more off. Maybe it's something about if…something's got a higher amplitude than it spreads. It has a higher chance of hitting something, right, because it spreads out more. |
| **2** | Observation  Incorporation of relevant prior knowledge  Inference  Intuitive reasoning | Louise: | I think light is being absorbed here [pointing at Figure 2]... but then it's also emitting photons. I think, that maybe I was wrong, and these are electrons from the metal, perhaps. I don't know why electrons would be [ejected], but I know elements are trying to, obviously, become a stable form. So, if they had one electron, in the outer shell, they want to get rid of that one, so I don't know if that could possibly just be released, or if it has to interact with another element. I know that elements would want to get rid of electrons that are in their outer shell that are making them not stable … I don't know if electrons can just be released into not another element. I feel like something else has to take them... |
| **3** | Observation  Incorporation of relevant prior knowledge  Inference | Phillip: | The electrons, if you excite them, they want to be in the ground state because that has the lowest amount of potential energy for them. And so lower potential energy is better in the sense that it's a more favorable position. So, if we increase the energy that they have, the reason that they don't want to stay there is because there's a place where they can have a lower energy state, which is ultimately what's favored. And so that would be why when they are [excited], their energy increases because they absorb this photon. That's why they want to return back to the ground state. |