Our Mission
As one of six Science of Learning Centers funded by the National Science Foundation, our mission is to create a new science of the temporal dynamics of learning in which we achieve an integrated understanding of the role of time and timing in learning, across multiple scales, brain systems, and social systems. We aim to use this understanding to inform K-12 educational practice. To do so, we created a new collaborative research structure, the network of networks, to transform the practice of science.

Questions We Ask
Tuning is critical for learning at every level, from learning the precise temporal patterns of speech and movement to appropriate sequences of movements, to optimal training and instructional schedules for learning, to interpreting the streams of social signals that reinforce learning in the classroom or the boardroom. TDLC initiatives address fundamental research questions such as:

- How is temporal information about the world learned and how do the temporal dynamics of the world influence learning?
- How can the intrinsic and extrinsic dynamic properties of brain cells and circuits facilitate and/or constrain learning and behavior?
- How can the temporal features of learning be used to enhance education?
- What are the best ways to leverage the temporal dynamics of learning in the brain and between brains?
- What are the temporal structures for body movements and the environment and how are they learned?

A Sampler of Innovative Research andFindings

- An activated brain state, as measured by cortical EEG, is essential for accurate encoding of sensory temporal patterns in both the auditory and visual modalities.
- Lower levels of (fast oscillatory activity) gamma power in the resting cortical EEG of an infant may predict early childhood language or attentional problems. This knowledge spurred the creation of early interventions for specific language impairments.
- The ability of a child (playing in a Gamelan musical percussion group) to temporally synchronize with an external source correlates significantly with established measures of attentional performance.
- By examining children playing group music in an instrumental setting, The SIMPSONY Project is one of the first longitudinal studies of its kind to study the effect of musical training on brain development.
- eMEG (anatomically constrained magnetoencephalography) demonstrates a “contralateral ear to hemisphere advantage” for auditory processing in real-time, confirming physiologically what has been hypothesized for decades, based on dichotic listening behavioral studies.
- Temporal coordination and in between brain regions (temporal synchronicity) may improve the fidelity of information transfer.
- Human cortical theta oscillations during free exploration encode space and predict subsequent memory and language.
- The frequency of an individual’s oscillatory activity (measured by cortical EEG) prior to the presentation of a word predicts their later memory for that stimulus.
- Neurogenesis (birth of neurons in the hippocampus) binds new memories together on short timescales (minutes to days) while providing a code for separating events that occur farther apart in time (weeks to months).
- Computational links have been forged between thermodynamics and prediction, showing that in order to be energy-efficient, an organism must be predictive.
- The brain’s visual perception system can automatically and unconsciously guide our decision-making through affective valence perception.
- During face recognition, the first two places we look at are around the nose, with the eyes being the third fixation.
- Scientists are attempting to develop robots trained to “read” a student’s facial expressions in order to improve intelligent tutoring systems.
- Scientists are exploring whether training autistic children to become “face experts” will improve their social skills.
- Researchers hope to teach Brain Computer Interfaces (BCIs) and other non-invasive interventions to help individuals with motor-sensory learning impairments.
- ModoCa: A new platform for model-based control is being released for public use. This will facilitate the testing and development of numerous optimal control applications, including new discoveries in motor control.

Diversity, Outreach & Education
TDLC is committed to enhancing student education with innovative and interactive experiences with science, industry and education professionals and the general public, and increasing the diversity of our Center and the scientific community. The Center offers opportunities such as:

- The Educator Network
- Summer Fellows Institute
- Annual FaceCamp
- TDLC Distinguished Educator Advisory Panel
- Small Grant Program
- Fellows Lecture Series and Retreat
- iSLIC Conference
- Summer TDLC Research Lab Internship Programs
- Language Training Programs
- Research Experience for Undergraduate Site Program
- Gamelan Project at The Museum School
- Research for Tournees
- The Preuss School Internship
- UCSD Neuroscience Outreach Group

Translation
Education is a well-developed discipline with a lengthy history. Neuroscience and computation are younger fields that are rapidly growing. At TDLC, we are dedicated to the integration of neuroscience and computation with educational theory and practice, and ultimately, translation of research findings into innovative technologies and programs such as:

- Creating groundbreaking computer games to help autistic children read faces (The Let’s Face It! and FaceFind games).
- Developing robots to help in schools: RUBL, a social robot, has taught colors and shapes to preschoolers using California standards.
- Robot baby, Diego-Fan, may aid in therapy sessions with special needs children one day.
- Writing computer models that can schedule students’ study sessions for optimal learning.
- Investing adaptive tutoring systems that respond to the user’s facial expressions.
- Developing cognitive and literacy skills training (FastForward) that can improve students’ basic writing skills.
- Creating a system for improving students’ memory for vocabulary words.
- Understanding the role of major musical training in learning and development.