In order to get at the 4 engineering components of design, systems, analysis and models, this lesson aims to have students working in small groups and going through these 4 phases with bristlebots.

Day 1 The Design Phase
Materials needed:
portable whiteboards and markers
Graph paper for log
Batteries
Motors
Toothbrush heads
A variety of materials that could be used for the bot such as paper clips, fuzzy pipe cleaners, etc.

Explanation of journals and content is done first 5 minutes.
Warm-up in journal: What are the constraints of a bristlebot?

The constraints are the minimum components needed to qualify as a bristlebot (toothbrush, battery and motor).

Play
For 5 minutes the students will have access to a toothbrush, battery and a motor.

Discuss
Return to seats and share out what they discovered and note in journals. Example questions that teacher can ask:
What does the schematic for a bristlebot circuit look like?
How can you control whether the circuit is on or off?
What materials can be used to keep it all together?
What are some issues that you might see with designing your bot?

The class will be split into groups of 3-4 students who will design a toy for a child based off of the bristlebot. Each student in each group will draw their own design in the journal in as much detail as possible.

After 10 minutes of drawing, they will share out within their groups and receive hot and cold feedback. After each student has shared out the group will work out a design that all can agree on (either a previously shared design, a new design, or a combination of the designs). Before agreeing upon this design, some time should be taken to reflect on possible sources of problems. These problems should be articulated in the journals. Once this task is complete,
the next iteration of the design should be noted in each member of the group’s journals. (D) (M) (A)

Within the teams, the students will split into different roles; electrical engineer, mechanical engineer and project manager. (S)

Return to the classroom seats and share out possible design problems for all groups. These problems will be listed on the board as a mechanical, electrical, or group problem. Possible solutions can be generated as a class.

Prototypes due by end of block on third day of class!

End of class-In journal, create a timeline of the next day and how long each task will take. Also, note additional materials needed for next class.