MEET IN THE MIDDLE

GOAL
Kids use math and communication skills to match "tunnel entrances" on opposite sides of the same piece of cardboard.

GRADE LEVEL
Upper elementary – middle school.

MATERIALS (for each team)
- large piece of corrugated cardboard or foam-core board
- 2 books or blocks
- 2 ballpoint pens
- paper
- ruler

DISCUSSION
One challenge of tunnel engineering is making precise measurements to ensure that teams building from each end of the tunnel come together in the middle. This was also an issue in building the first intercontinental railroad, with the east and west teams meeting at Promontory Point, Utah. Here, students see the importance of choosing which measurements to make and communicating them accurately.

ACTIVITY
Step One
Organize the class into teams of two. Stand cardboard on edge between the partners and hold in place with the books or blocks.

Step Two
First team member: holding onto the cardboard to keep it standing, draw a circle about the size of a penny somewhere on your side of the cardboard. Label the circle A. This is the entrance to Tunnel A. *Second team member:* draw a circle on the other side and label it Tunnel B.

Step Three
Partners take turns describing the location of Tunnels A and B. Based on description, each partner draws the other end of A or B.

Step Four
Use the pen to carefully punch a hole where you think your partner's Tunnel B is. Your partner punches a hole where s/he thinks Tunnel A is. Now turn the cardboard around to see how well you communicated!

Tip: Encourage kids to consider different ways of communicating the locations of their tunnel entrances using the materials they have.

FURTHER EXPLORATION
Provide each team member simple building materials, such as straws and paper clips, or toothpicks and gumdrops. Partners sit back to back. One partner builds a simple structure, with step-by-step description. The partner should follow those directions at the same time. When finished, see how closely the two structures match up.

Take away: Challenge kids to design and build a tunnel through a box of sand, without touching the sand with their hands and using only 4 toilet-paper tubes, paper, tape, and a paper cup.

CONNECT TO ENGINEERING
No matter how good the engineering concept, a project won't work if engineers can't communicate accurately and effectively.

With more than six million kilometers of highways and 240,000 kilometers of railways snaking across the United States, life above ground has become increasingly congested. Tunnels provide some of the last available space for cars and trains, water and sewage, even power and communication lines.

Did you know? In the Middle Ages, medieval armies launched sneak attacks on enemy castles by digging tunnels through sandy soil under moats. The men dug tunnels not only to gain entrance to a castle, but to destabilize and topple it. They supported their tunnels with timbers, which they then burned to collapse the tunnel — and hopefully the castle as well.

This activity from American Society of Civil Engineers: Building Big