Notetaking Guide for the movie about the Samurai Sword. KEY

1. What is the title of the movie: The Secrets of the Samurai Sword
2. Where is the Samurai Sword from? Japan
3. What are samurai? Warriors, army, aristocracy sometimes mercenaries
4. How do modern samurai test their swords? cut through bamboo
5. How old is the Samurai Sword? Approximately 1000 years
6. What are two abilities of swords? Piercing or slashing.

In the traditional smelting method,

7. Where does the iron ore sand come from? Local rivers
8. How many days does the traditional iron maker stay awake to make steel? 3 days and nights
9. What is the worker doing with the furnace? Making sure the furnace is maintained at the right temperature.
10. What happens in the center of the furnace? Fe and C combine

A Materials Science Engineer explains what happens with iron at high temperatures:

11. What happens with the iron atoms at high temperatures? More space between atoms
12. What happens when the iron cools? C gets trapped in between the atoms. It transforms into steel and becomes very strong.

Circle Yes or No

13. People can control mechanical properties by heating and cooling metal. YES or NO
14. People can control metal properties by heat treating. YES or NO

In the traditional smelting process . . .

15. Does the iron ever reach a liquid state? YES or NO
16. Does the traditional smelting process produce only one kind of steel? YES or NO

There is a limit between hardness and brittleness.

17. What test method is used to test toughness? Charpy test

    Tough metal: it bends doesn't break. It tears apart.

    e.g., taffy or tootsie rolls, bends before it breaks

Back to the traditional smelting

18. How does the traditional iron maker know when the process is complete? He watches and listens to fire to determine when the steel is good.

    Furnace broken apart to extract steel. Ingot is cooled.
    Pieces that fall off easily are brittle.
    The good steel pieces are sent to the sword maker.

A Materials Science Engineer explains what the shape of the sword.

19. What sword shape is good for slashing? a curve
20. What sword shape is bad for slashing? Straight blades

The sword maker is a traditional blacksmith.

21. How does the blacksmith shape the steel into a sword? Hammer, hammer, hammer

    It takes brute strength to hammer the hot metal.

22. What do the texture and color of the steel indicate? amount of Carbon

The hammer releases sparks.

23. What are the sparks? slag or contaminants

    The bend of the softened steel indicates quality.

Brutal level of hammering and bending

24. What happens to the steel after the hammering and bending? The material gets harder.

    Bending makes metal get harder.

The Materials Science Engineer makes a demonstration about bending.

25. What happens every time the metal is bent? Microscopic defects make it stronger

Back to the traditional blacksmith (sword maker)

26. Why does the metal get reheated after hammering? Makes metal soft again so it can continue to be hammered into shape.

One steel is hard. Another type is tough but cannot hold an edge.

27. Which steel goes on the outside of the sword? Hard steel
28. What goes in the middle of the sword? The soft steel which is tough and flexible.

Hard steel outside for cutting edge
Core is tougher to bend to absorb impact
Same method used for modern structural steel.

Traditional rating system of swords is no longer performed.

Quenching process

29. What indicates that it is time to quench? Color indicates temperature
30. What does the quenching do to the hard steel? Hardens steel for razor sharp edge

Quenching affects outer metal not tough metal in center

31. What does the quenching do to the soft steel? Cooling contracts the core. It shrinks a lot. This is where the curve comes from the different cooling rates.

Core has a face on the top of sword which pulls the hard steel into curve.

After the sword maker is done . . .

32. Where does the sword go? Sword polisher