

Way to Go, Indigo!

Lab Overview- In this investigation you will take on the role of an industrial scientist as you examine a process used by jeans manufacturers to soften and lighten denim fabric. You will identify problems with one industrial process, and investigate a possible solution by using your understanding of biological molecules.

Background- Denim jeans were designed in the 1840's to be tough outdoor clothing for farmers, miners, and cattle ranchers. These jeans were stiff and uncomfortable until they had been worn or washed many times. Eventually, jeans became fashionable, but consumers wanted to buy jeans that were already comfortable. Manufacturers had to develop methods to provide new jeans that felt and looked "worn in".

To understand denim you should be familiar with some properties of cotton. Cotton plants produce seed-bearing capsules called bolls. The bolls contain white balls of fuzzy fibers surrounding cottonseeds. The fibers are actually the cell walls of dead cells. These cell walls are made of a carbohydrate called cellulose. **Cellulose** is a long chain of glucose monomers. Multiple cellulose chains are linked together by hydrogen bond. The chains wrap around each other, forming larger and larger strands.

To make denim cloth, manufactures spin the cotton fibers into threads. The naturally white threads are woven together with threads that have been dyed blue. When the threads are dyed, molecules of the dye (called indigo) become trapped between the cellulose fibers, making the threads appear dark blue.

As denim is worn and washed several times, the cellulose fibers start to break and wear thin. As the fibers break, the indigo dye is released and the fabric softens and becomes more flexible.

Manufacturers discovered that washing jeans with pumice stones sped up the softening process. However, stone washing caused several problems:

1. The pumice stones took a toll on the industrial washing machines, which had to be replaced frequently.
2. Additional employees were needed to pick the pumice stones out of the pockets of the jeans.
3. Many jeans had to be destroyed because the pumice stones caused too much damage.
4. The pumice stones wore down to a sandy sludge that clogged drains and sewer lines.
5. Pumice has to be mined, which can have negative effects on the environment.

A better method of preparing denim was needed! Researchers have discovered the enzyme **cellulase** could provide an alternative method of breaking down the cellulose fibers. As cellulase breaks down the fibers, the trapped dye is released. The fabric surface becomes fuzzy as threads fray. Some sort of agitation (shaking, scrubbing, or abrasion) is important to complete the breakage of weakened fibers.

Introduction- In this lab you will start with three swatches of denim. You will perform an experiment to test the effectiveness of the enzyme cellulase to create comfortable jeans.

Way To Go Indigo Lab Answers

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Way To Go Indigo Lab Answers:

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Table of Contents Way To Go Indigo Lab Answers

1. Understanding the eBook Way To Go Indigo Lab Answers
 - The Rise of Digital Reading Way To Go Indigo Lab Answers
 - Advantages of eBooks Over Traditional Books
2. Identifying Way To Go Indigo Lab Answers
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Way To Go Indigo Lab Answers
 - User-Friendly Interface
4. Exploring eBook Recommendations from Way To Go Indigo Lab Answers
 - Personalized Recommendations
 - Way To Go Indigo Lab Answers User Reviews and Ratings
 - Way To Go Indigo Lab Answers and Bestseller Lists
5. Accessing Way To Go Indigo Lab Answers Free and Paid eBooks
 - Way To Go Indigo Lab Answers Public Domain eBooks
 - Way To Go Indigo Lab Answers eBook Subscription Services
 - Way To Go Indigo Lab Answers Budget-Friendly Options
6. Navigating Way To Go Indigo Lab Answers eBook Formats

- ePub, PDF, MOBI, and More
 - Way To Go Indigo Lab Answers Compatibility with Devices
 - Way To Go Indigo Lab Answers Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Way To Go Indigo Lab Answers
 - Highlighting and Note-Taking Way To Go Indigo Lab Answers
 - Interactive Elements Way To Go Indigo Lab Answers
 8. Staying Engaged with Way To Go Indigo Lab Answers
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Way To Go Indigo Lab Answers
 9. Balancing eBooks and Physical Books Way To Go Indigo Lab Answers
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Way To Go Indigo Lab Answers
 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
 11. Cultivating a Reading Routine Way To Go Indigo Lab Answers
 - Setting Reading Goals Way To Go Indigo Lab Answers
 - Carving Out Dedicated Reading Time
 12. Sourcing Reliable Information of Way To Go Indigo Lab Answers
 - Fact-Checking eBook Content of Way To Go Indigo Lab Answers
 - Distinguishing Credible Sources
 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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