

## Bread Structure

Glutens form a network to trap CO<sub>2</sub>  
Wheat flour is mostly starch...

Recall meringues set by heat...  
Albumin proteins for a network  
Sugar reinforces when water is removed



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## Gluten and Starch

When baked, starch granules  
absorb water, swell, and “set”  
Starch pops  
bubbles  
Steam escapes



Image: <http://www.seriousseats.com/2011/06/the-food-lab-the-science-of-no-knead-dough.html>



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## Modifying Gluten

Flour type – high protein (↑ gluten)  
Oxidizing substances (↑ gluten)  
“Wet” dough (↑ gluten)  
Lots of kneading/mixing (↑ gluten)  
Salt (↑ gluten)  
Sugar (↓ gluten)  
Fats & Oils (↓ gluten)  
Acid (↓ gluten)



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## Baking – Charles’ Law

How big do bubbles get?  
Assume a 1mL bubble @20°C  
heating up to 65°C

Race between expanding gas &  
stiffening gluten



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## Steam in Baking

Phase changes  
Steam transfers heat better  
Keeps surface elastic longer  
Glossy crust



Image: <http://tic.howstuffworks.com/home/wash-and-dry-with-steam.htm>



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## Stale...

Changes in the starch  
Gel loses water, crystallizes

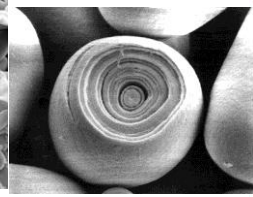
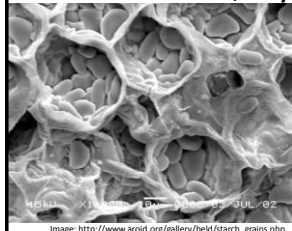


Image: [http://www.roid.org/gallery/hold/starch\\_grains.php](http://www.roid.org/gallery/hold/starch_grains.php)

Image: <http://sciencegirlsnock.wordpress.com/2011/05/30/women-of-outstanding-achievement/>



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# Science to the rescue!

Stale bread can be “fixed”

Consider the food molecules

Starch – need to re-gel

Heat

Storage conditions



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