



Am

**Cooking the Perfect Steak
the 2.29 Way!**

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**O n t h e
M e n u
T o d a y**



P a r a m e t e r s & M o d e l



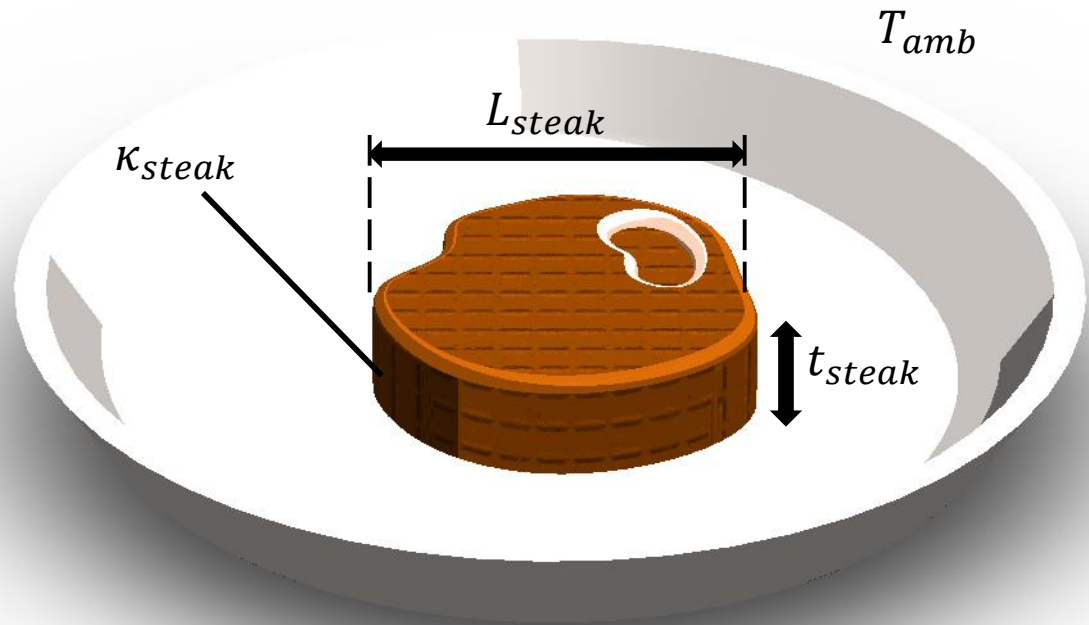
**C o o k i n g S t e a k
i n M A T L A B**



D i d I t C o o k ?



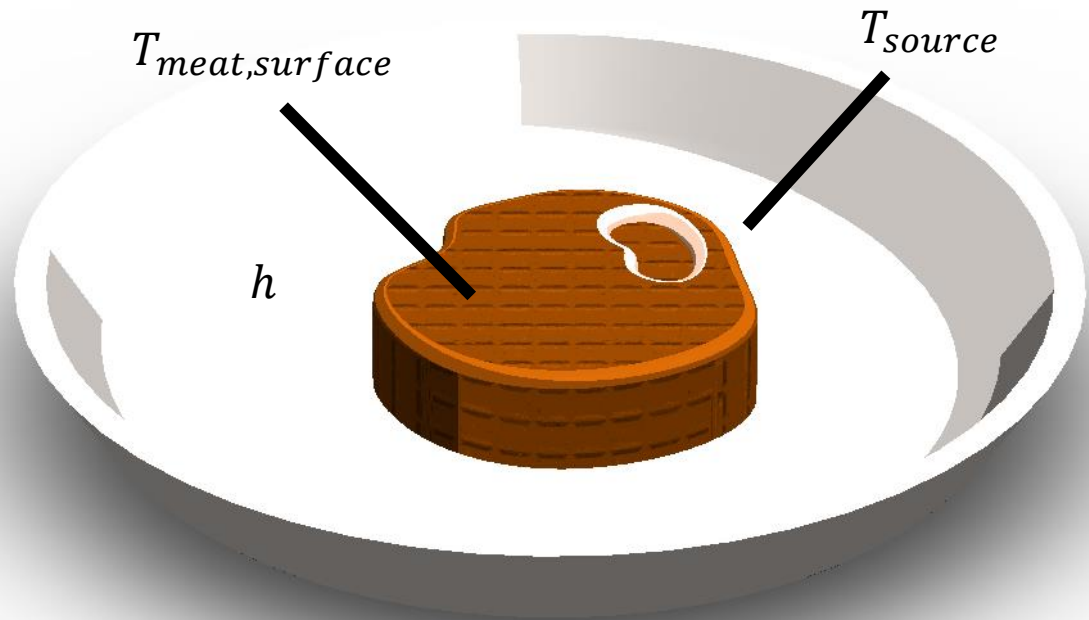
Properties of Steak



Property	Value
L_{steak}	0.10 m
t_{steak}	0.02 m
κ_{steak}	$0.231 \frac{W}{m^{\circ}C}$
$T_{steak,i}$	18°C
T_{amb}	20°C
h_{side}	$0.373 \frac{W}{m^2^{\circ}C}$
h_{bottom}	$5.73 \frac{W}{m^2^{\circ}C}$



Governing Equation



$$Q = hA(T_{source} - T_{meat,surface})$$

(Q is the heat flow rate)



Model Assumptions

Meat conductivity is independent of temperature.

What am I ?

Constant heat flux from pan.

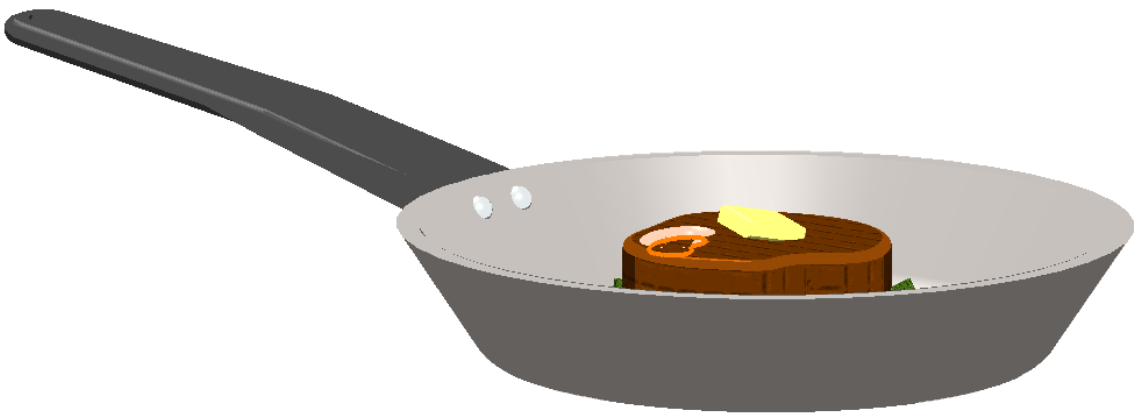
Meat does not lose moisture.

Time dependent Neumann boundary conditions on all sides

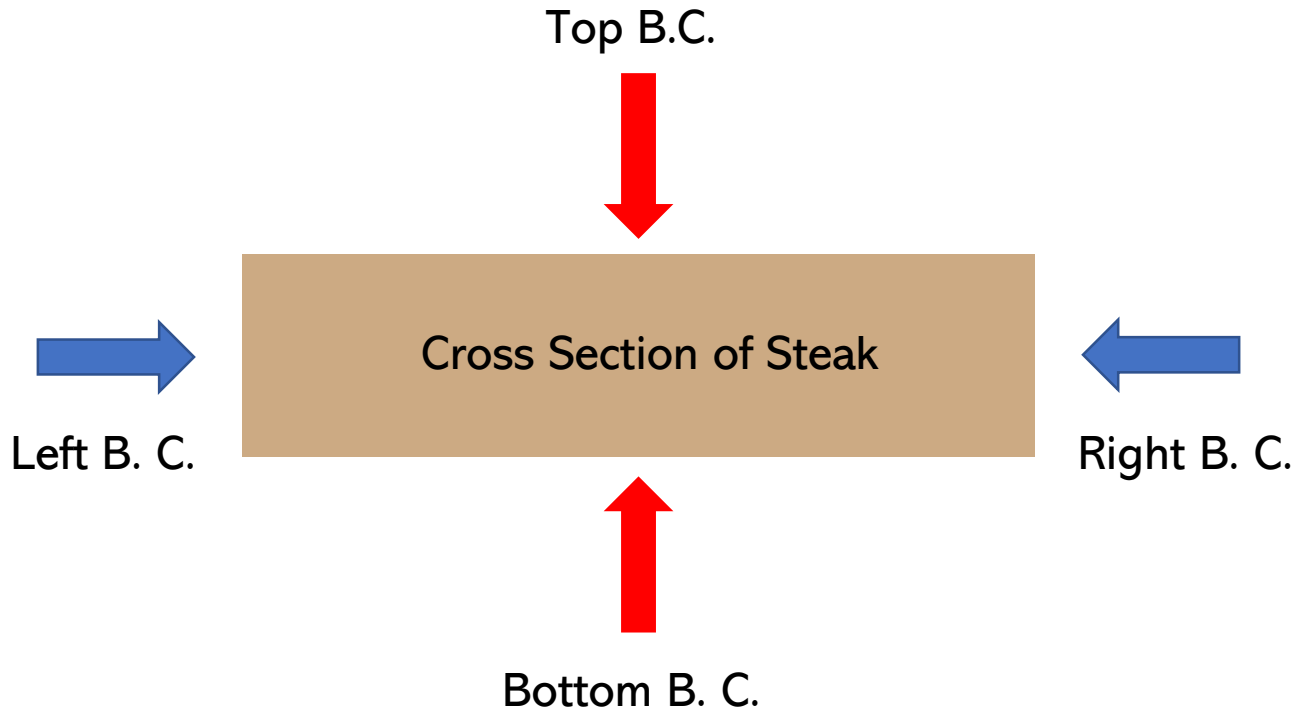




Model of Steak



Boundary Conditions

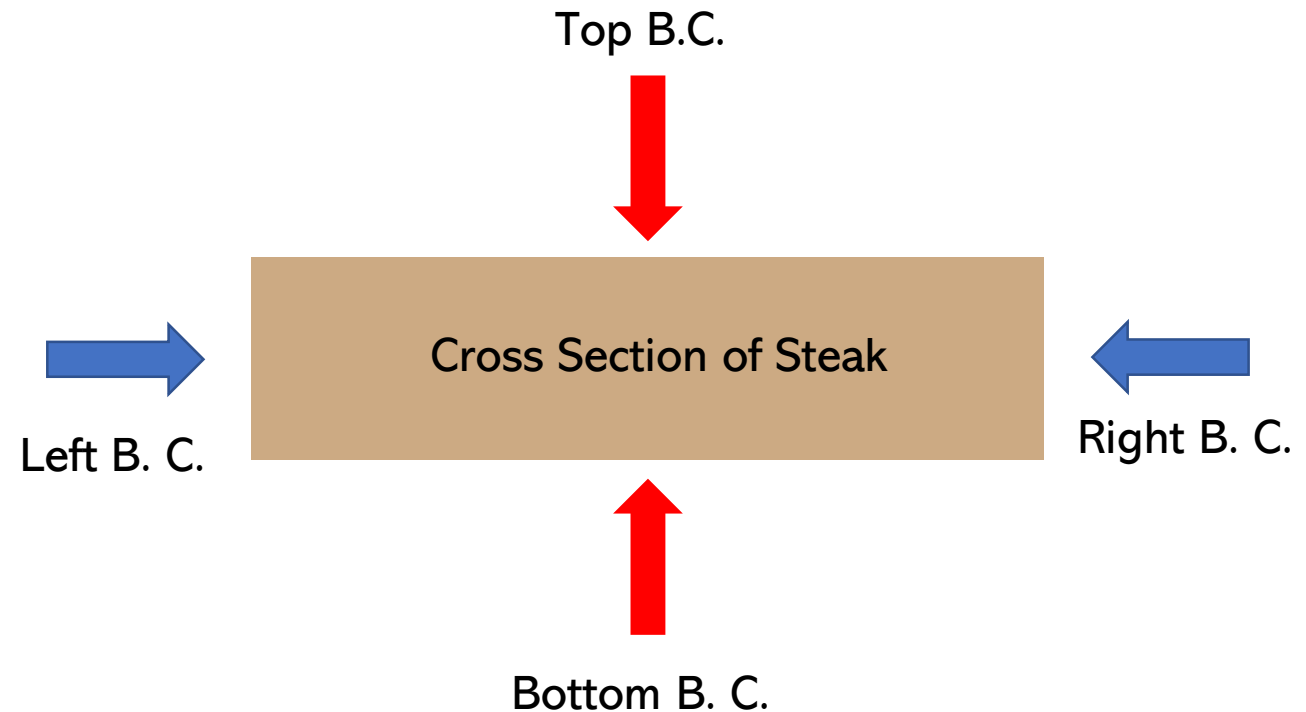
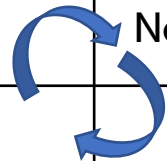




Boundary Conditions

Boundary Conditions at Each Side of Steak






Side of Steak	During Cooking	When Flipped
Top*		Newton Cooling
Bottom*	Constant flux	
Left	Convective heat loss	
Right	Convective heat loss	



*When the steak is flipped, the top side is exposed to Newton Cooling

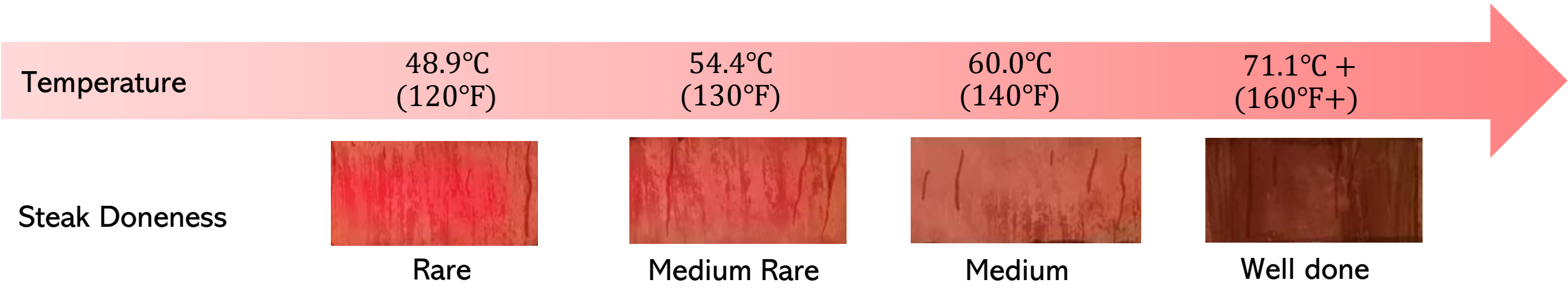


MATLAB Model Summary

-  Modified from 2.29_FV_Framework
-  Implements a 2D heat equation over a rectangular domain with Neumann boundary conditions
-  Square wave to control flipping of the steak
-  Solves the heat equation by a Finite Volume discretization on a uniform Cartesian mesh (no source term)
-  Uses a second-order backward difference time marching scheme and uses LU factorization to solve the linear systems.

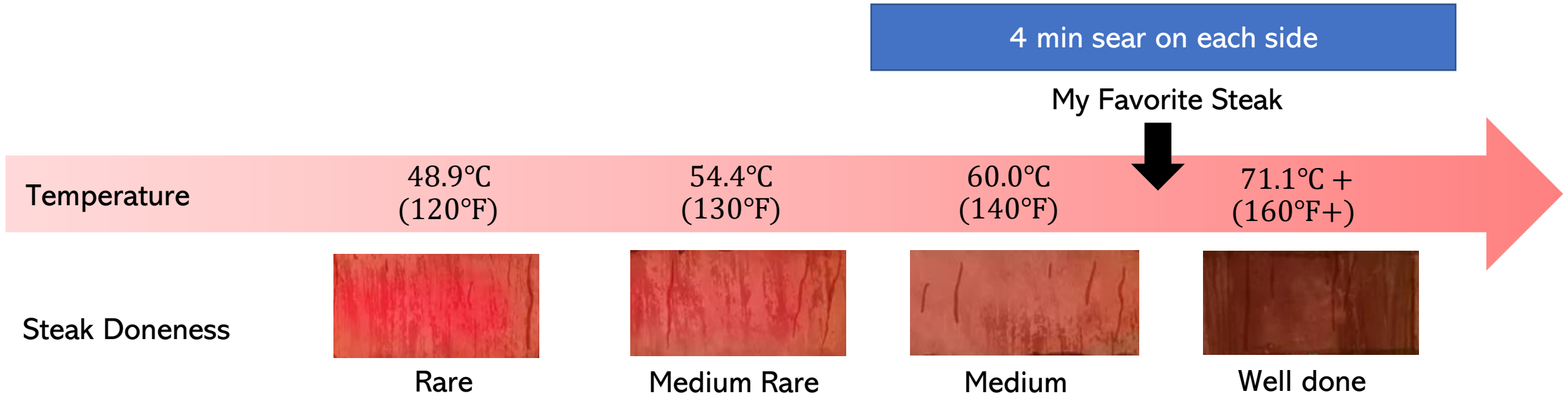


How Well Did It Cook?



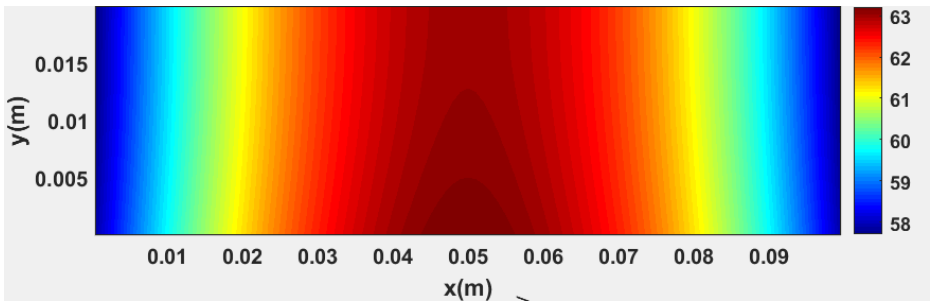


How Well Did It Cook?









How Well Did It Cook?



4 min sear on each side

Simulation

Temperature	48.9°C (120°F)	54.4°C (130°F)	60.0°C (140°F)	71.1°C + (160°F+)
Steak Doneness	 Rare	 Medium Rare	 Medium	 Well done

Lessons Learned & Future Works

Don't cook your
steak in MATLAB!

Cook the perfect
vegetable

You can use 2.29
to understand
food science.

Cook using two
methods: searing
and oven

Doneness also depends
how long you leave steak
out.

Varying
conductivity as a
function of meat
temperature.

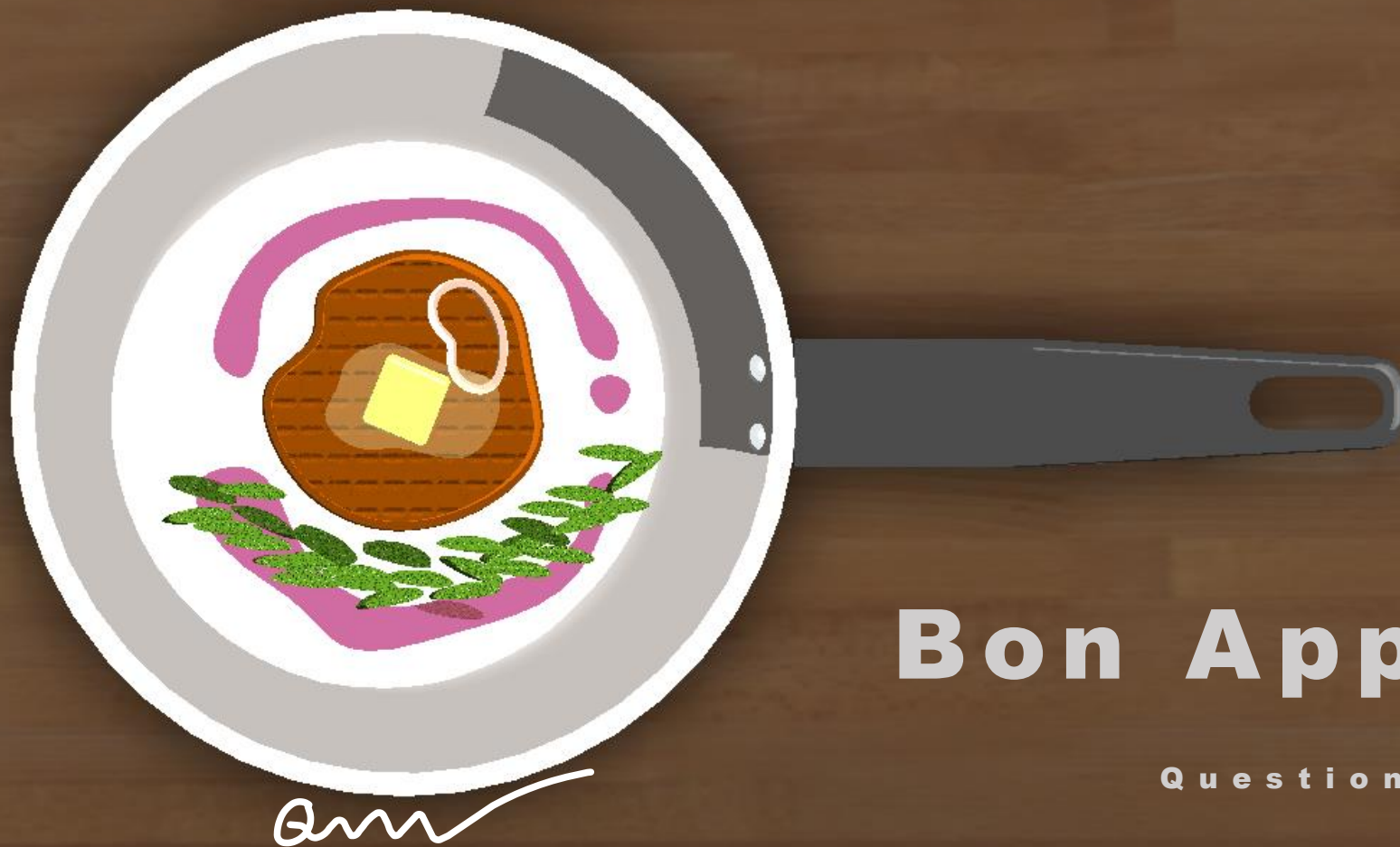




Ann

Special Thanks to the 2.29 Staff!





Bon Appétit!

Q u e s t i o n s ?

