



Lab Prep

Bituminous Mixture Preparation and Testing

CE 331





Materials

Materials

Mixing

Sample Prep

Mixture Designs

Strength Testing

Analysis

Example?

Report

- Bitumen
 - Naturally occurring
 - Organic byproduct
 - Hydrocarbons
- Asphalt cement
 - Distillation of petroleum
 - Graded by viscosity
 - Many different types





Types of Asphalt Cement

Materials

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Example?

Report

- HMA
 - 200 to 300 F
 - Summer paving season



- WMA
 - Lower temps (30 to 120 F lower) through chemistry additions
 - Reduce costs
 - Better Compaction
 - Patches

fhwa.gov

asphaltpavement.org



Types of Asphalt Cement

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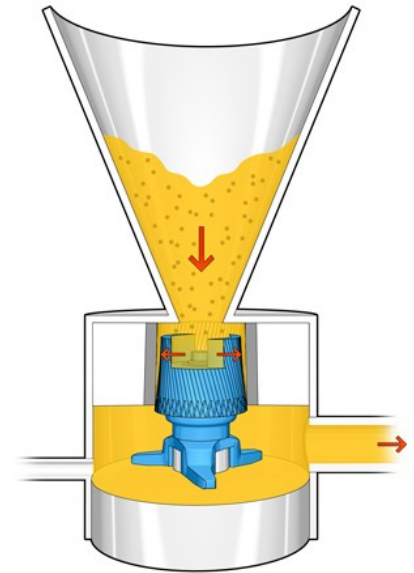
Strength Testing

Analysis

Example?

Report

- Emulsion
 - asphalt, water, soap
 - Colloidal mill
 - Brown is good
 - Hardening (drying) process is referred to as “breaking”
 - Room temperature
 - Typically only 2/3 asphalt!!



romaco-us.com



Pavementinteractive.org



Asphalt Concrete

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Example?

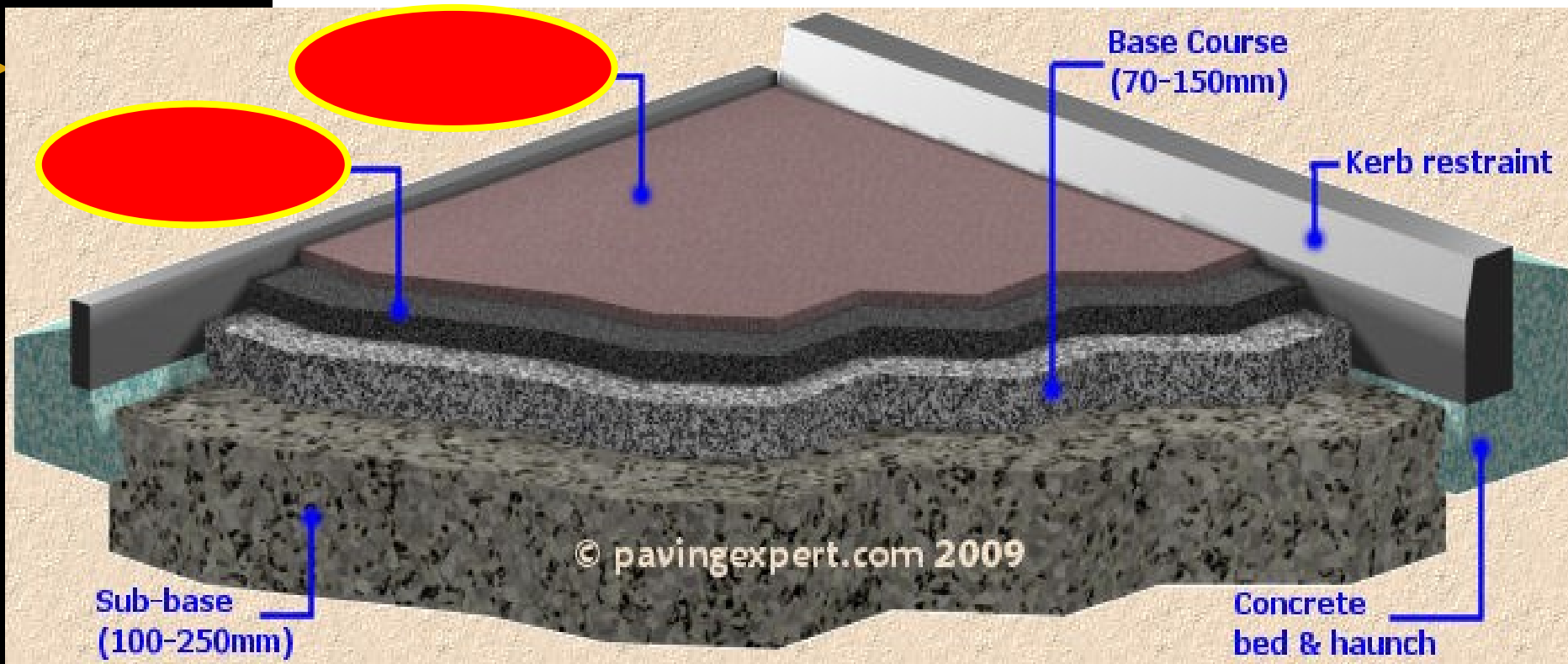
Report

- Asphalt concrete
 - Aggregate + binder
- Strength/stability
 - aggregate (type and gradation)
 - asphalt (type and content)
 - state of compaction





Asphalt Concrete - Types



Report



Asphalt Concrete - Types

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- Surface Mixture
 - Topmost 1" – 2"
 - Provide smooth, stable top layer
 - Low permeability, noise
- Binder Mixture
 - Next 2" – 4"
 - Not as stable or dense
 - Spread mechanical loads
 - Coarser gradation

**Which
mixture do
you think is
more
expensive?**



Aggregates

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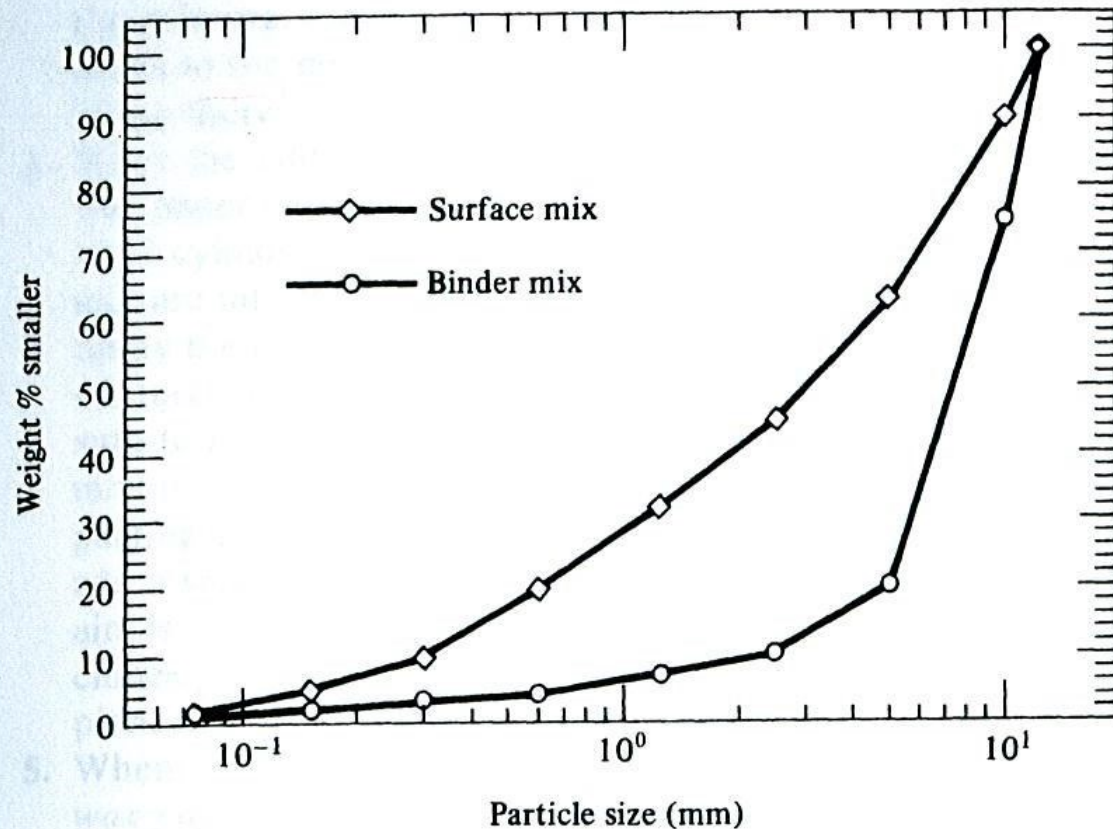


FIGURE 19.1
Aggregate gradations for bituminous mixtures

Courtesy Dr. Seidel

Penn State Harrisburg



Setup

Materials

▶ Mixing

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Example?

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Mixing

Materials

► Mixing

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Example?

Report

- Weigh 3 sizes of aggregate
- Mix the coarse aggregate and $\frac{1}{2}$ of the sand
- Add the emulsion and mix
- Add the rest of the sand and mix for at least 5 minutes
- Make sure the aggregates are as well coated as possible





Filling the Molds

Materials

Mixing

▶ Sample Prep

Mixture Designs

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Example?

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- Cylindrical Molds:
 - $\varnothing = 2.5''$, $h = 3.0''$
 - spray interior of mold with silicone spray
 - Wax paper on pedestal and spray it with silicone
 - Place the cylinder on compaction pedestal and carefully spoon mixture into the mold until it is full





Compacting the Samples-

Materials

Mixing

▶ Sample Prep

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Example?

Report

- 4 lb., 18" fall
- Spray bottom of compacting hammer with silicone. Wax paper always between pedestal/sample
- Put on your gloves!
- Drop the weight 30 times, adding more material. Invert and repeat
- Total compactive effort of 120 drops





Mixture Proportions

SURFACE MIX					
Sample	1/2" - 3/8" (g)	3/8" - 1/4" (g)	Sand (g)	Emulsion Weight (g)	Mold's label
1	40	138	290	29	
2	40	138	290	33	
3	40	138	290	37	
4	40	138	290	41	
5	40	138	290	45	
BINDER MIX					
Sample	1/2" - 3/8" (g)	3/8" - 1/4" (g)	Sand (g)	Emulsion Weight (g)	Mold's label
1	57	204	213	26	
2	57	204	213	30	
3	57	204	213	33.5	
4	57	204	213	37.5	
5	57	204	213	42	



Next week....



Strength Testing

Materials

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Sample Prep

Mixture Designs

► Strength Testing

Analysis

Example?

Report

- Unconfined compression
- Constant deformation rate 0.1 in / min
- Peak load for each specimen
- Check blackboard for the data
- Screw-type mechanical machine





Specimen inspection

Materials

Mixing

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Mixture Designs

► Strength Testing

Analysis

Example?

Report

- Uniform loading
 - Defects
 - Loose materials
 - Unparallel ends





Data Analysis

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► Analysis

Example?

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- $m_{\text{asphalt}} = \frac{2}{3} \cdot m_{\text{emulsion}}$
- $AC = \frac{m_{\text{asphalt}}}{\text{total mass}}$: Asphalt Content
- Plot strength vs AC
- Fit a 2nd order polynomial



Data Analysis

Materials

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Sample Prep

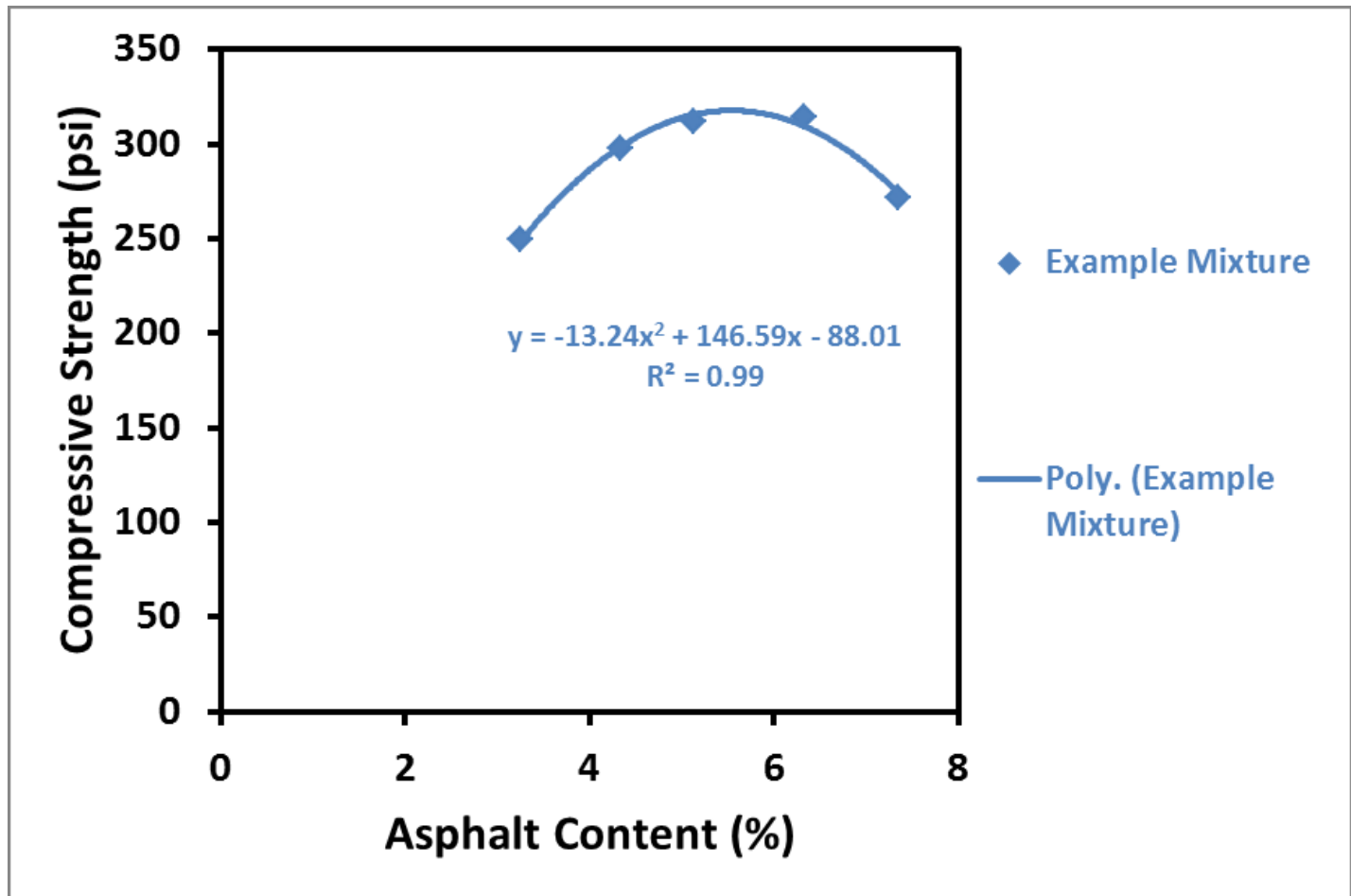
Mixture Designs

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▶ Analysis

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Optimum Asphalt

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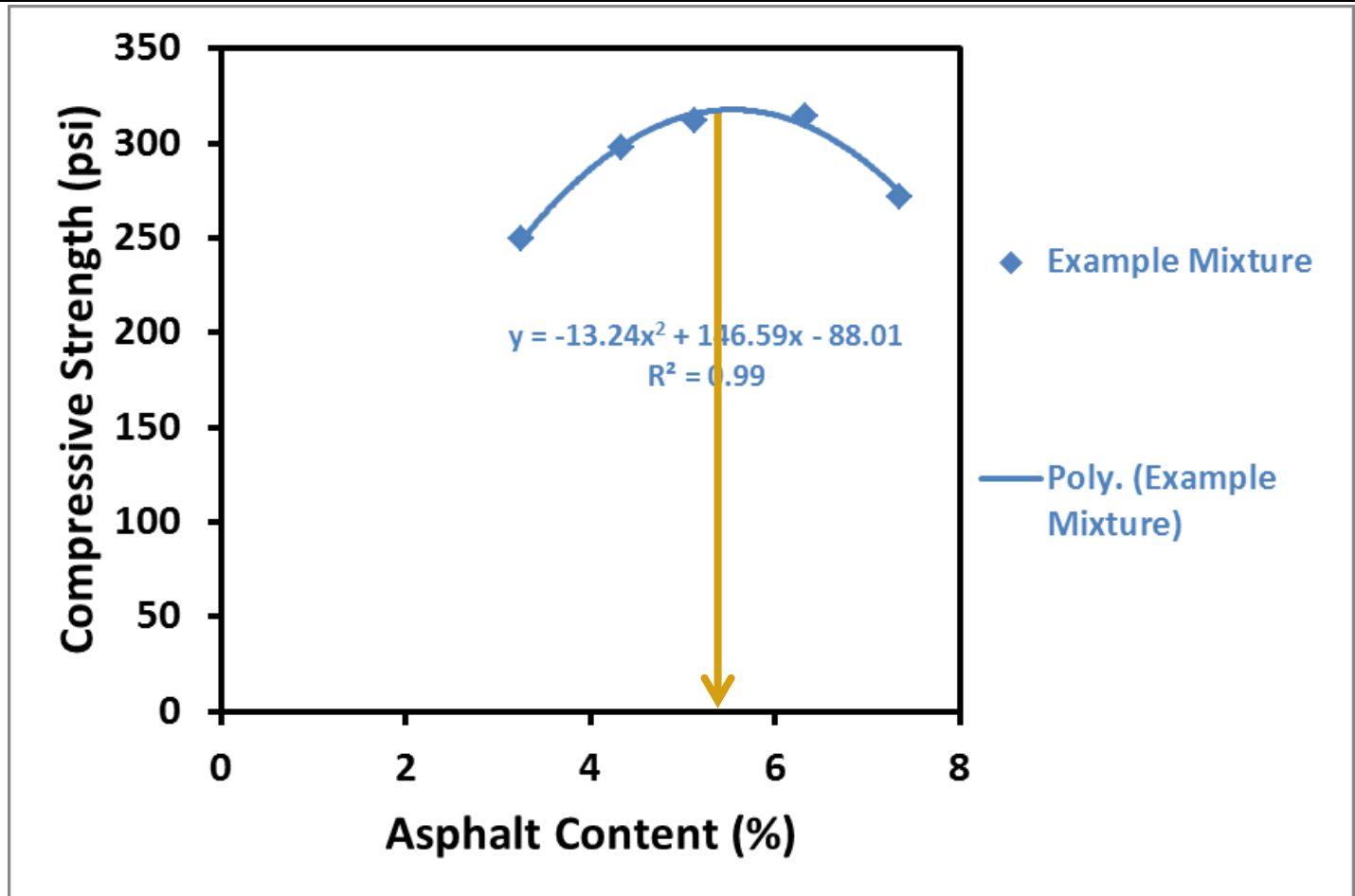
Mixture Designs

Strength Testing

▶ Analysis

Example?

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Optimum asphalt content corresponds to highest strength



Example if you want...



Report

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Example?

▶ Report

- Last Lab Report!!! (w00t)
 - Let's make it fast, but go out with bang!
- Executive Summary / Plots and Table / Data in Appendix
- Rubric on bb
- Possible questions to answer in summary are provided on next slide



Report

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Example?

▶ Report

- Comment on the mixing effort and appearance of the mixture with various asphalt contents
- Comment on the effect of asphalt content on compaction
- From a strength standpoint, what is the optimum asphalt content of each mixture?
- What other aspect of the mixture might cause you to select an asphalt binder that does not give you the maximum strength?
- Why is the surface mix stronger at optimum asphalt content, than the binder mix?
- Why does the surface mix have a greater optimum asphalt content?



Report

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Example?

▶ Report

- Plots
 - Strength vs asphalt content for binder and surface
- Summary Table
 - Here are the column headings

Sample #	Emulsion Weight (g)	Max Load (lb)	Max. Comp. Strength (psi)	Total Mass (g)	Asphalt Content (%)
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Questions?

A farmer buys a talking sheepdog and sends him out onto the farm. The dog gets all the sheep into the pen, and then goes back to the farmer.

"There you go boss", he says. "All forty sheep are safely in the pen."

"Forty?", says the farmer. "I only have thirty-six sheep."

"Yeah, I know", says the dog. "But you asked me to round them up."